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ABSTRACT

The feasibility of undertaking a major university-wide library systems development program for the University of California libraries was studied from July 1970 to March 1971. The findings indicate that such a program can provide significantly improved library services while at the same time offering long term fiscal advantages to the University and the State of California. The new mechanized systems will produce equivalent savings equal to the initial investment for development in five to ten years after they are operational. (Author/SJ)

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LIBRARY SYSTEMS DEVELOPMENT PROGRAM

LSD 71-23A

FINAL REPORT OF THE FINDINGS
OF THE
FEASIBILITY PHASE

issued by
Fred L. Bellomy
on behalf of the
UC LIBRARIES

2 April 1971

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I. CONCLUSIONS AND RECOMMENDATIONS

I.A. Justification

The libraries of the University of California will sooner or later make significantly increased use of electronic data processing machines and the associated technologies. The inevitability of this is a foregone conclusion which is seldom seriously challenged. Specifically, if the University is unable to create a single cooperative library development program, continued uncoordinated development at each of the individual libraries must be expected.

The librarians wish to automate for three reasons. First, mechanization will provide services being demanded by their patrons. Second, mechanization will help solve their management and administrative problems. Third, they will mechanize because this is the best way known to increase the productivity of clerical and professional library personnel.

I.B. Service Benefits

Benefits of the new systems being envisioned by the libraries of the University of California are great, indeed. Increased use of the University's library resources most certainly will occur as the difficulty and user time are decreased. If we were permitted to put a price tag on the value of users' time saved, this would approach a third of a million dollars a year from the mechanized circulation procedures alone. (See Section IV.D.3). The new mechanized circulation and order processing procedures will increase a user's chance of getting the information he wants when he seeks it. The impact of this on the quality of education provided by the University will be significant.

The need to divert the time of library staff members to more direct service is apparent. Huge cabinets of cards containing information which has been copied over and over by regiments of human beings using manual methods are remnants of an era when better alternatives were not available. The substitution of machines for manual labor where machines are better suited for the tasks will permit the more humane use of staff resources in libraries.

No machine will ever perform all of the important analysis and evaluation tasks which libraries are now able to do only "as time permits" or when a crisis occurs. When such tasks can be done on a more consistent and systematic basis, significant improvements in the quality of both library management and service can be expected.

Mechanization will produce a number of bibliographic publications needed by the UC Libraries, as well as other libraries in the country. Income from the sale of these new products might amount to as much as $40,000 per year, not including the sale of the Union Catalog Supplement.

I.C. Cost Benefits

Our analyses of two areas of library operations, ordering and circulating books, disclosed many areas where machines could take over the work of human beings. The cost of the labor which could be replaced by mechanization is currently running about $800,000 per year. However, these replaceable costs must not be construed as direct "savings" to the University. These personnel are currently needed just to maintain the existing quality of service in the face of increased work loads. Staff relieved of clerical duties by the use of machines will be shifted to other work until the increases in staffing level catches up. What will happen, is that the productivity of the library staff will increase as they learn to make effective use of their new machines. This increased productivity will not occur immediately; it will take a long time and will occasionally be painful. The resulting "savings" will be largely offset by new costs which will be required to support the new machines and the people to operate them. Nevertheless, it is clear that a significant portion of anticipated workload increases can be handled by the level of staffing which exists at the time of implementation of the new systems so that future increases in library staff requirements (particularly in clerical ranks) can be correspondingly smaller than they have been in the past.

In a sense, increased productivity can be viewed as "savings" to the University. For example, each time one more book can be ordered by the existing staff, this "saves" the University about $1.69. Similarly, each time the receipt of one more item can be handled by the existing staff, this "saves" about $.47. Finally, each time one more book can be circulated without increasing the staff size, this "saves" about $.37. Furthermore, every year these unit "savings" grow larger because the staff salaries are increased to keep pace with inflation.

The machines which make increased productivity possible are not free, of course. Initially, the new machines and the people to operate them will cost nearly a million dollars per year and this is after an initial investment of between $1.8 and $3.3 million to do the preliminary systems work and implement new mechanized systems for ordering and circulating books. Operating "savings" will not begin to accrue until about three years after the development process begins and it may take five to ten years after the new systems are fully operational before the "savings" will equal the initial investment. Because the machine costs for each unit of work handled will decline with each passing year (if the two decade-old trend of a 33% cost reduction per year continues) (Reference 38, page 31) while the labor cost for each unit would continue to rise (due to inflation and static labor productivity), the annual unit cost "savings" will grow every year the new systems are in operation.

Thus, in addition to the considerable improvements in library service and the quality of operation, mechanization definitely can be expected to produce long term fiscal advantages to the University and the State of California.

I.D Best Computer

Our studies of various ways of putting computers together for use in libraries have led us to four tentative conclusions. First, the diversity of UC Library requirements suggest relatively sophisticated systems concepts. Second, the specific kinds and quantities of machines which must be used depend heavily on the nature and diversity of the functional requirements specified by the UC Librarians. Third, the total cost to the University is lower when the libraries share the use of a single large computing machine than when each acquires one for its exclusive use. (However, differences in file sizes and activity on various campuses may make some decentralization of machines imperative.) Fourth, competition is keen and machine vendors can be expected to work vigorously to show us how their equipment can satisfy our requirements at a lower cost than the competitor's.

Our machine configuration recommendations at this point are tentative. This is because we have made the overly limiting, but conservative, assumption that the equipment would be used only for mechanizing the book ordering and circulation functions of the libraries. It is known that existing library data processing applications and library school instructional applications could benefit from access to computing machines dedicated exclusively to UC library related activities. The excess capacity of the computers required to handle occasional peak loads would be available most of the time for these other purposes. Further, we have not reflected the possibility of obtaining state and federal subsidies which would partially offset the costs of acquiring machines.

We have looked in some detail at the existing and future library data processing requirements for ordering and circulation books in order to determine the kinds and sizes of machinery which will be required. Presently our studies indicate that a large data processing machine (such as the IBM System 370/135) connected by telephone lines to additional equipment at each of the campuses is the least costly way of meeting known requirements. The additional equipment at each campus may include data processing machinery for controlling a large number of special terminals located in the libraries at the various work stations.

I.E. Cost Summary

The cost of developing new mechanized systems for ordering and circulating books will depend on the specific arrangements which are made for acquiring the libraries' central computer. Using the most pessimistic of the alternatives discussed in Section V.D. and the development cost projections presented in Reference 1 (pp. 46-50), we obtained the costs summarized in Figure I-1. Note that the "conversion" costs (to prepare half the libraries' collections for mechanized circulation) are assumed to be absorbed by the existing staff during the Implementation Phase. Also note that the Cost "Savings" are really costs avoided by requiring fewer people to handle the expected increased workloads (Section V.D.).

The development costs, summarized in Figure I-1, are higher than those assumed for developing the ordering and circulation functions alone (Section V.D.) because the estimates of costs incurred in long range systems integration and program management (pp. 47, Reference 1) have been included. These figures may be interpreted as the total funding requirements for the first years of the UCLSD Program. If the development of additional functions (as proposed in Reference 1) were authorized later, additional development funds would be required.

I.F. Recommended Action

Our studies lead us to conclude that new mechanized library systems for the Univeristy of California are (1) inevitable, (2) desired by the staff and patrons, (3) offer significant improvements in library service, and (4) offer long term fiscal advantages to the University and the State of California.

We recommend, therefore, that the University seek major state funding to support the development of the Order Processing and Standard Loan Subsystems. We further recommend that budget negotiations be started immediately between the President's Office and the UCLSD Program Review Committee for the Requirements Phase of the Order Processing and Standard Loan Subsystems so that the study of requirements for these two subsystems can begin on 1 July 1971. Detailed program plans are now being made by the UCLSD Program Office and the UC Libraries.

FIGURE I.1
COST SUMMARY

FISCAL YEAR	PROJECTED DEVELOPMENT COSTS ($1000)					PROJECTED OPERATING COSTS ($1000)*						"Savings" OVER NEW COSTS
	Develop Hard-ware	Implem. Hard ware	Design Person-nel	Conversn Person-nel	TOTAL DEVELOP COSTS	Central Hard-ware	Communi-cation	Campus Hard-ware	Central Person-nel	Campus Person-nel	TOTAL OPERAT. COSTS	
71/72	129	-	273	-	402	-	-	-	-	-	-	-
72/73	384	-	325	-	709	-	-	-	-	-	-	-
73/74	76	681	566	(100)	1323	-	-	-	-	-	-	-
74/75	-	518	614	(100)	1132	92	30	171	73	75	441	145
75/76	-	-	336	-	336	199	67	399	166	170	1001	214
76/77	-	-	140	-	140	199	67	399	174	178	1017	288
77/78	-	-	-	-	-	199	67	399	183	187	1035	360
78/79	-	-	-	-	-	108	67	394	192	197	958	443
79/80	-	-	-	-	-	16	61	223	201	207	708	529
80/81	-	-	-	-	-	16	59	200	212	217	704	621
TOTAL	589	1199	2254	(200)	4042	-	-	-	-	-	-	-

*Absorbed by replaced personnel during Implementation Phase.

II. ESSENTIAL BACKGROUND

II.A. What Is the UCLSD Program?

The main objectives of the UCLSD Program are three: first, to improve the quality of library services provided to patrons; second, to increase the productivity of the library work force; and, third, to substitute a centrally managed, nine campus cooperative mechanization effort for the nine independent and often duplicate efforts.

The earliest documented effort to achieve all three of these objectives occurred in November, 1964 when the UC Library Council endorsed the "Library Research Institute" proposal "...that a three man task force be organized to attack the pressing, operational problems of the UC libraries about which early administrative decisions must be reached." (Reference 41) Thus, the library's concern for improving their operations through the application of modern technologies is long standing and even predates the Governor's survey on efficiency and cost control of 1967 which signaled a significant increase in tempo in library systems development work. The UCLSD Program is a direct response to instructions received from the President of the University (References 17 and 18 and Appendix B). The University librarians have demonstrated their support both collectively in the Library Council (Reference 19) and individually (Appendix A of Reference 1) as well as through their technical representatives on the Library Systems Task Force (Reference 20).

The transition from many, uncoordinated, partially experimental computerization projects at the nine campuses to the concept of a centrally managed, cooperative University-wide approach (Appendix A) has been a long, arduous, and expensive journey. Our organization is far from perfect. The managerial structures of an operational program can not be determined at this time. The Library Council will be giving this problem its attention in the near future. The potential for misunderstanding is exceedingly great for everyone working on the program. Still, the opportunity for a successful venture has never been higher. Cooperative systems development work is perhaps less desirable to individual systems staff members than would be the pursuit of projects of their own selection. But in the larger perspective, cooperative development is clearly in the best interests of the University.

II.B. Characteristics of the UC Libraries

Taken together the libraries of the University of California represent one of the largest and most active research library resources in the world. In addition to directly serving the students, faculty and staff of the University, it also serves as the prime research library for the general population and industry of the State of California. Indirectly these libraries are a national resource, in that users throughout the country obtain unique materials from them through interlibrary loan transactions.

The libraries of the University of California currently employ well over 2,000 full time staff members and an even larger number of part time student assistants. The current library payroll totals about $16,000,000 of which a little less than half goes for salaries of librarians. Historically, increased work loads and the pressures of inflation have driven these costs up by 13 to 20 percent per year (1965 to 1970). (Appendix C).

There are over 11,000,000 volumes in the 70 libraries on the nine campuses of the University (Reference 22). This makes the holdings of the entire UC library system the largest in the Western United States. In order to keep pace with the needs of the University and the publication growth trends the number of volumes held by the UC libraries has increased by 5% annually in even the leanest years (Reference 42) with a much higher rate in better years (Appendix C).

The diversity of the libraries in the UC system is reflected by the number of volumes held which range from a few hundred to well over 3,000,000 in the main library on the Berkeley campus. The subjects covered by the libraries reflect the full spectrum of man's knowledge with libraries devoted to subjects as diverse as Optometry, Forestry, Music, East Asiatic Studies, to name just a few. In addition to the 11,000,000 "ordinary" bound volumes held by the libraries approximately 20,000,000 more items are housed in the libraries including manuscripts, maps, micro-copy, pamphlets, sound recordings, artifacts and momentos, photographic slides, photographs, newspapers, and serials to name just some of the categories.

The physical arrangement and location of libraries differ greatly from one campus to another, mostly because of the varying academic programs in progress at the campuses. The training, experience, and personal goals of library staff members vary significantly from one campus to another. This diversity of library resources is, in itself, an important asset to the University. This same diversity, however, complicates the process of introducing new technologies to the libraries on a coordinated, University-wide basis. Still, our libraries must make better use of the modern technologies in order to have any hope of decreasing the rate at which operating costs increase with each passing year.

"Increases in the productivity of the working force have occurred throughout the history of the United States. In the century since the end of the Civil War, output per worker has increased nearly six times; the average American worker produced almost six times as much in the 1960's as his grandfather a century ago." (Page 46, Reference 43) "Since the 1870's, the average compound rate of growth in output per worker has been around 2% per year. This rate has varied considerably from one period to another. It has been influenced by wars and droughts, by prosperity and by depression, by changes within the farm and non-farm sectors, by governmental action, and by enumerable economic and social factors, in addition to technological change _per se_". "...From 1959 to 1965, as nearly as can be ascertained, output per worker grew at 3% a year." (Reference 43).

Information on the productivity of library workers is very scarce. Most studies are concluding (Reference 32) that in view of the relatively static technology in use by libraries, the productivity of library labor has remained relatively unchanged for decades. Even the most optimistic interpretation of the data would not permit a rate in excess of 1.5% per year to be deduced. (Pages 13-16, Reference 32). Some improvement should have occurred because there have been some notable changes in the ways libraries do business. There has been increased attention to the use of modern management techniques, the use of typewriters and office copy machines, the wide-spread use of photographic and other relatively unsophisticated mechanized circulation procedures and a reduction in the amount of original cataloging performed by a typical library. Much more significant changes are going to be required before libraries can expect to match the productivity doubling every 25 years which now characterizes the rest of the American economy.

With long term growth of library workloads probable (increased enrollment of 5% per year and increased publication rate of 4% per year) and less adequate financial support for the UC Libraries at least possible, the need for steps which will increase the productivity of library labor is clear. Mechanization can provide that increase.

II.C. Options for Automation of the UC Libraries

A number of points need to be made for considering the various alternatives available to the UC libraries. First, greater mechanization is inevitable. Second, it is expensive and some alternatives are more expensive than others. Third, it takes a long time before benefits of any kind are evident. Fourth, the optimum technology is uncertain. With these constraints in mind, let's take a brief look at three different basic approaches to mechanization.

REVERT TO LOCAL DEVELOPMENT. While nine separate development projects, no doubt, ultimately would cost the University more money and while the quality of the results would vary considerably from one campus to another, there are some very distinct advantages to this approach. If a library had the necessary technical capability and the money, it could undoubtedly complete the mechanization of any particular function in less time than it would take to do the same thing for the entire University. Furthermore, because there would be no need to compromise design requirements to accomodate the needs of other campus libraries, the systems developed would be more acceptable to the staff of that library. Each library would be able to work on that aspect of its operation which it felt deserved highest priority at its campus (and the priorities do vary significantly from one campus to another). (Reference 1.) Generally speaking, personal motivation of systems staffs working on projects with which they can personally identify and which will predominantly reflect their own creativity will be high. The particular systems approach selected could be tailored to reflect the personal preferences of the campus. There would be almost no need for interlibrary cooperation on systems development - a process acknowledged by everyone to be difficult (Reference 28).

CENTRAL PIECEMEAL PROJECTS. With this approach, additional projects would be undertaken similar to the Union List of Serials and the Subject Authority Control projects now in progress. This approach has the advantage of permitting wider variations in funding support. If there was less money, fewer projects would be undertaken. This approach would permit all of the UC libraries to proceed together while at the same time minimizing the turmoil associated with implementing major new mechanized library operations. By limiting the scope of each individual project, the risk of failure would be minimized and the chances of producing usable results in a reasonably short period of time would greatly increase.

COORDINATED CENTRAL DEVELOPMENT OF SUBSYSTEMS. The development of all subsystems defined for the UC libraries would be undertaken (with funding authorized one subsystem at a time). Funding authorization would be obtained for one entire subsystem development with budgeting phased over several years. Initially, a single subsystem (Order Subsystem) would be authorized, but authorization for subsequent subsystems would be anticipated so that during a particular year, work on several subsystems would be in progress at the same time. While the development of a subsystem to meet the requirements of all UC libraries would take longer than if it were done for a single library, the total development cost would be less than nine independent projects to develop similar subsystems. By pooling the talents of library systems staffs available within the University, it should be possible to devise systems superior to those developed by individual campus systems staffs along. This approach opens up the possibility of adopting solutions (such as shared use of large computers) which would not be practical for a single campus.

ANALYSIS. In evaluating these alternatives, it should be borne in mind that in the absence of a strong, well-coordinated, well-managed central development effort, most of the University Librarians warn that they will be forced to revert to some level of local development activity. A decision to continue with central development, but on a piecemeal basis would mean a wider latitude in the funds which needed to be committed to the program and, generally speaking, would not be accompanied by an obligation to provide continued funding in the future. The final results derived from a piecemeal approach, however, would quite likely produce many incompatibilities between (and often within) systems developed. Without the careful and comprehensive design of a system before its development and implementation, one cannot hope for a smooth working, cost effective system.

Coordinated central development, the approach which we recommend, promises both the greatest risks and the greatest rewards for the University. This approach has the greatest possibility of providing dramatic cost benefits in the long run. Program budgeting with continuous program review would largely replace level of effort budgeting. Once the development of a subsystem were authorized, this would carry with it the obligation to provide the full amount of development money required to complete the project. The project could be stretched out in order to reduce annual funding requirements, but this would likely increase the total development cost. Any project could be cancelled at the completion of any of the first three phases (requirements, specifications, or design) prior to commencing the implementation phase, but such action would be expected only under extraordinary circumstances. The implementation schedule could be adjusted to spread the major costs of new hardware required at the campuses over longer periods of time. But, once the decision was made to implement a subsystem, this would imply an obligation to provide the necessary funds eventually for the new hardware required at all of the campuses.

This approach requires, by far, the greatest degree of interlibrary cooperation. Our own experiences and evaluation (Reference 44) as well as those experiences of others (Reference 28) have taught us a great deal of respect for problems associated with interlibrary cooperation on projects of the complexity and magnitude we are now planning.

In this respect, the initial stages of the UCLSD Program have been a valuable learning period. Without question, the feasibility of the task team approach discussed in Appendix A has been demonstrated. Despite some operational problems which have arisen (too few people to accomplish too many tasks and distances which restrict rather than facilitate communication, creating additional burdens on task team leaders and central staff members), success has been achieved. On tasks with well-defined goals and assignments, these difficulties have been overcome, making joint effort a reality. There are at least two other dimensions to the problems associated with this approach. First, because of the wide range of specialties which must be brought to bear on the problems of the libraries in a program of this magnitude, the participants sometimes have difficulty understanding one another. The same observation is true for communication between the participants and those who review the results of their work. During the Feasibility Phase, ground work has also been laid in this area and new lines of communication between the new central staff and all members of the library community have been opened. The second important dimension relates to significant differences in objectives which various concerned groups would like to see the Program achieve. Some would simply like the new systems to help the libraries create order where there is currently chaos. Others would like to see significant new services provided for the library patrons. Still others would like to find a way of slowing the explosively rising costs of operating the University libraries. Each group is fully justified in its position and clearly has the University's best interest in mind.

II.D Feasibility Phase Description

The Feasibility Phase of the UCLSD Program began formally in July of 1970. This report concludes most of the feasibility study work. During the study eight major tasks were undertaken (Reference 33).

The first task was a study of potential cost benefits (Section V). It included, (1) an analysis of library functions to determine how great the replaceable costs might be and, (2) what may be the most comprehensive measurement (using cost accounting techniques) of existing manual library costs ever attempted by any organization the size of the University of California. The results of these studies may well be viewed as a milestone in the development of Library Science.

The second task was a study of potential service benefits (Section IV). This included a questionaire sent to a sample of 5000 UC Library users to assess their satisfaction with existing library services and their expectations for further growth. Like the cost study, this effort likely will be viewed as an important milestone in Library Science. Along with this user's study an in depth analysis was performed of service benefits which should be expected from the mechanization of the book ordering and circulation functions (Appendix K).

The third task was a study of alternate means for using computers for ordering and circulating books. The computing needs of all of the libraries were determined for these two functions and the capabilities of several computer configurations were simulated (Section III, and Appendix F). The UCLSD Program staff worked closely with the Coordinator of Computer Activities in the office of the UC President to insure that our recommendations are in accord with the University's Master Plan for Computers.

The fourth task was a test of the proposed development methods. This test which envolves the development of a University-wide Subject Authority Control system is still in progress and we are, indeed, learning from it.

The fifth task was the installation of a mechanized project management system. This is now in operation.

The sixth task was an attempt to integrate the UC funded Catalog Supplement Project into the UCLSD Program. This Institute of Library Research (ILR) project has produced results of potential use to the UCLSD Program, and efforts to make use of these are continuing.

The seventh task was an attempt to integrate the extramurally funded Center for Information Services Project into the UCLSD Program. This UCLA/ILR project is still in the development stages and the long range implication for other

UC Libraries are still being studied.

The last task was the development of a UC Union List of Serials. This effort is progressing toward successful completion by the end of this fiscal year

II.E Feasibility Phase Limitations

The degree of involvement of library staff members varied from one campus to another. At some campuses there was extensive discussion with line staff regarding the questions raised by the Feasibility Phase. At others there was less. Not until the sixth month of the Feasibility Phase was a coordinated effort made to directly involve line staff in the proceedings. The cost study, utilizing job cost accounting techniques, was one effort to elicit direct participation of all library staff members likely to be involved with the mechanized systems. Almost no one enjoyed the cost study and most minunderstood its purpose; orientation, too often, was not given adequate attention. Reactions from cost study participants (Appendix W) substantiate this observation.

Limited time and resources prevented us from making all of the detailed cost measurements we would like to have made and forced us to limit the cost measurement to only two areas of library operations, ordering new material and circulating books. The annual salaries of people working in these two areas as measured by the study totalled approximately 4.4 million dollars. This represents about 28% of the total library payroll. It would have been preferable to have structured a cost study which accounted for all library operating costs in order to be assured that significant cost elements were not inadvertently overlooked.

Perhaps the most important limitation of the Feasibility Phase is the method used in assessing the magnitude of potentially replaceable costs. Ideally, we should have been much farther along in developing a concensus on the nature of the new mechanized library system to be developed and it would have been desirable to model this new system in sufficient detail to develop reliable estimates of new personnel requirements. Ideally, it would have been well to have been able to study a real system similar to the one we planned to implement in order to assess the reasonableness of our estimates. None of these things were possible. The libraries of the University have not even agreed on a fundamental system concept at this point. We have not yet asked the librarians to specify in a systematic fashion the requirements which each of the new systems must satisfy. We were forced, again by the pressures of time and resources available, to consolidate the known and obvious requirements which had been discussed at various times in the past and to conceptualize a single hypothetical system capable of satisfying those requirements utilizing known techniques. An overly sophisticated concept was assumed (see Appendix U) in order to insure that safe hardware costs were projected with the knowledge that less sophisticated systems probably would evolve and could be obtained at a cost lower than had been estimated for the purpose of establishing the economic feasibility of developing new systems for the libraries.

With the need to provide financial justification for the proposed development in a very short period of time, a sense of urgency enveloped the entire staff working on the feasibility analysis. A very tight schedule was followed which seldom permitted as much time for analysis and review at the campuses as would have been desirable. Future planning must take cognizance of this need for greater campus participation in the planning and analysis work of the Program, and must especially include responsible librarians whenever key steps are considered.

III. LIBRARY COMPUTER ALTERNATIVES

III.A Summary and Conclusion

The computer alternatives available for Order and Standard Loan automation may be viewed in two ways. One way is to consider the degree of man/machine interaction involved in ordering and circulating material. Interaction may vary from none, if batch processing is used exclusively, to constant interaction if user oriented terminals are attached to the machinery. The other way to view the alternatives is to consider the degree of centralization of computing machinery. The range of variation is from a machine for each campus on the one hand to a single machine serving all the campuses, on the other hand. Two generalizations about the two categories stand out:

1. increasing the degree of interaction increases costs, and
2. for any given degree of interaction, a single machine servicing all the campuses is cheaper than individual machines.

The Order and Standard Loan procedures, especially Standard Loan, require up to the minute information. If information is not current, the service provided is degraded. The less interactive alternatives do not keep the data totally current, and for this reason are less desirable. The recommended solution is to implement an interactive system in order to provide up to the minute information to librarians and patrons and to do it on a central facility to conserve costs. Such a system would provide the best service to library users while at the same time minimizing the expense of providing that service. Such a system also provides the opportunity to take advantage of the computing resources already available within the University.

III.B Four Approaches

The computing alternatives available to the library order and circulation automation program are considerable in number. Several totally different arrangements of equipment can be proposed as solutions. Three levels of decision making are involved in the process of selecting the best alternative. The most general level is described as the "system concept" level. It is primarily concerned with how the system would be used by and useful to library personnel. This level describes and explains library operations as they would exist in an automated environment. This level must concern itself with the needs and requirements of the libraries. It is planned and expected that librarians from all the campuses along with the systems people from all the campuses would contribute to the system concept decisions. The next level down from the system concept level might be called the "configuration" level. The concern at this level is what arrangement of machinery and what organizational structure would best do the job required by the system concepts. The final level might be called the "vendor" level. The decision here is which vendor or vendors will provide the best solution to the library system requirements and configuration requirements. System concept decisions will influence configuration decisions, at least to the extent that some configurations gain more plausibility by being more "in tune" with the system concept. Configuration decisions will, in turn, influence vendor decisions. We will see how these levels relate in the following paragraphs.

At the system concept level, four main approaches to the Order and Standard Loan Systems may be distinguished. These approaches differ from one another primarily in how they update the computer data storage files. They also differ in their handling of terminal devices. These differences have implications for the availability of information and for the working procedures of a library's Order and Circulation departments. Some arbitrary names have been given to the four approaches. The names: batch, inquiry, on-line queue, on-line update. Each of the four approaches will be explained and related to the two levels below the system concept level.

1. BATCH

A "Batch" system, for the sake of this discussion, is one where all files are updated in a batch mode. No single action such as a book charge, or a purchase order creation ever causes a data record to be immediately created or changed. In this sense, "batch" means "batch only". Such a system may have the most elaborate data collection equipment, such as point-of-sale light pens or CRT devices, or it may employ the more basic types of data input as the keypunch. But what characterizes all the types of data entry devices is their stand-alone mode of operation. In a batch only system, the data entry device would not be attached to a computer. Rather the transaction would be captured on some off-line storage medium such as magnetic tape, paper tape, cassette tape, or punched card for later processing in the batch mode.

Information available from the batch only system is almost always in the form of printed listings. Second would come all of the other forms of output including punched cards, microfilm, magnetic tape etc. Careful planning must be done in order to insure that the information contained in the listings is not too out-of-date, especially for the larger libraries where the print requirements could be voluminous. Some examples of Order and Standard Loan work flow in a batch mode are included in Appendix D.1.

The batch only system, per se, does not entail either a centralized or decentralized configuration. The batch only mode of operation could be handled by smaller local machines at each campus, or by a larger central machine which is on-line to a batch work station at each campus. In either case courier service would have to be provided between a campus' local machine and its circulation desks and acquisition areas.

2. INQUIRY.

An "inquiry" approach is one which has on-line access to the files via remote terminals, but the access is for inquiry only. The files cannot be updated from the terminals but are updated in the batch mode just as described in the batch system. In addition to the terminals connected on-line to the computer for inquiry, we would still need the stand alone terminals for data entry as described for the batch system. This approach differs from the batch approach essentially by replacing volumes of listings with remote terminals. The inquiry system, like the batch system, does not entail a hardware configuration. The terminals could be tied into a local machine on each campus. They could, on the other hand, be hooked to a remote central machine, along with remote batch work stations to handle the batch updating that is still necessary. Either way is possible.

3. ON-LINE QUEUE

An"on-line queue" approach is one where the main files are still updated in batch mode on an overnight basis, but, the daily transactions are placed as they occur into separate disk files, one file for each type of transaction. The daily transactions are not organized in their files in any particular order. They are just added to their respective files one after another as they occur. They are queued up, as it were. This system, then, contains main files which are organized according to some key data element and are current up to the previous evening, plus it contains separate and distinct daily transaction files which keep a running account of the daily activity. The daily transaction files, in addition to being written into, may be searched and read from. Then each evening they are emptied by merging their transactions into the main files and are ready for receiving the next day's transactions.

An essential part of this system is the use of data entry terminals having a direct link to a computer. New orders, received orders, received invoices, charges, discharges, holds, etc., would be captured at the instant of transaction and placed in their respective daily queues.

The on-line queue system does not entail a specific hardware configuration although it makes more demands on the alternatives. On-line queueing is the simplest form of on-line disk update, but it is nonetheless on-line disk updating. The logic and attendant software necessary to insure the integrity of data in an on-line disk update mode results in increased hardware requirements for backup and, more significantly, it requires larger machines to hold the more complex programs necessary to insure data integrity. On-line queueing, being the least complex case of on-line update, requires less programming than a full fledged on-line update,but it still requires considerable additional programming. Thus, three types of configurations are available to the on-line queue mode:

1) medium sized local machines for each campus.
2) a large central machine holding both main and daily files, and driving one remote batch station and several remote terminals at each campus, and
3) a large central machine holding the main files, and a local processor at each campus holding the daily files and driving local batch equipment and local terminals.

All three configurations provide the same service from the point of view of the terminal users. See Appendix D for sample configurations.

4. ON-LINE UPDATE

The "on-line update" approach is the one which places all changes and additions directly into the main files. The daily transaction files are non-existent, and so is the need for the overnight batch merging of daily transactions into the main files. The data entry devices for this system can be any type of on-line device. Circulation may employ book card data entry or light pens. Acquisitions may use

CRT's, mark sense readers, or anything else that is convenient. But the programs are different. The programs take a transaction and immediately update the main file. These programs must have sufficient logic to insure that transactions are never lost as a result of machine failure. The programming requirments are the most demanding of any of the four systems, but nonetheless on-line update systems are in use regularly today in many businesses and applications.

As in the previous cases, this system does not entail any unique hardware configuration. Configurations that would handle the job include:

1) medium sized machines at each campus (slightly bigger than for on-line queuing because the programs are bigger),
2) a large central processor holding all the files with a small local processor at each campus to control terminals, and shuttle both inquiry and update type requests into the main processor,
3) a large central processor directly linked to the terminals on all the campuses and directly receiving their inquiry and update requests.

Information flow would be the same for any of the three configurations. See Appendix D for examples of information flow and sample configurations.

5. ALL APPROACHES

All four approaches must provide for back-up procedures when the machine fails. Preferably the back-up would be another machine of some type, so that when the main equipment became ready again, it could automatically query the back-up equipment and thus avoid personnel time spent in recovering the transactions. But no matter how many levels of machine back-up, a manual back-up system can and will be provided for those emergencies when all machines fail.

All four approaches must also provide for data security. Procedures will be designed so only properly authorized persons will have access to any campus' data. Some people will be allowed to see but not change the data. Others will be allowed to both see and change data.

III.C. Hardware Costs for the Four Approaches

Total costs will be understood to include all costs arising from automation. The cost estimates will include costs for computer equipment and services, communications equipment if any, building alterations necessary to house the equipment, all personnel associated with the program and all other related costs. The costs cited in this section will be the costs at the point in time when all nine campuses have fully implemented the Order and Standard Loan subsystems. A later section, Section V.C., will estimate costs over time as the program gradually expands to handle more tasks within the Order and Standard Loan Subsystems.

The biggest cost of hardware is the computer and its storage devices. To better estimate the computing capacity required for Order and Standard Loan, a survey of the nine campuses was made to estimate the size and usage of the present manual files employed in these two subsystems. Then the manual files were analyzed in light of how their information would be handled by machines. From this analysis, actual machine storage requirements were calculated, and processor speeds estimated. The resulting machine requirements for each of the four approaches are listed in Appendix D along with their detailed costs. The summary costs are stated below. Appendix E.1 details the methods and results of the survey. Appendix E.2 contains the estimates of the machine files based on the analysis of the manual files.

As an independent check of our own calculations and estimates, we retained Systems Architects, Inc., a consulting firm specializing in simulation and versed in library applications. The data from the Order and Standard Loan file survey was reported to them. They simulated the two subsystems under the decentralized batch approach, the centralized batch approach, and on the centralized on-line approach. The batch and on-line approaches were simulated because they represent the two extremes of responsiveness demanded of the machine. The batch approach needs only overnight response, and work may be scheduled manually. The centralized on-line update approach demands immediate response from a single machine for all transactions coming in from all campuses. Since it must have the capacity to handle peak loads, this approach requires the fastest processor of all the approaches. Hence, the simulation study was designed to show up the range of processors required from the smallest to the largest. We can extrapolate from these results to intermediate processors. The detailed simulation results are in Appendix F.

SAI simulated IBM equipment only for this feasibility study. This is not to construe that IBM equipment would be the hardware used for any systems developed. The equipment merely represents examples of the levels of power required by the various configurations. Vendors can be asked to propose hardware of equivalent power, and more simulations can be run before procurement. SAI's basic conclusions are as follows.

For decentralized batch, IBM 360/25's would handle all the campuses. For centralized batch, an IBM 370/145 will handle the projected workload with less than a 50% utilization. For centralized on-line update, a Model 145 would also handle the workload. SAI did not draw any conclusions about the relative merits of the batch versus the on-line update approach for library effectiveness. And neither did SAI do a cost analysis of the various approaches, except to mention some possible ways of cutting the costs presently itemized in Appendix D. SAI's job was to fit a machine to the workloads presented by the two approaches they were given, and this they have done.

Given the excess capacity of the Model 145 for the centralized batch case, it was felt that the Model 135 would be adequate. This was discussed with SAI and this feeling was orally confirmed, although the 135 was not simulated. For the centralized on-line update case, SAI felt much more reluctant about the 135 because of the need to reserve capacity for peak-load demands. Therefore, a machine with the power of the 145 must be considered for centralized on-line update.

Based on our calculations and the results of Systems Architects simulations, we have selected machine sizes for each of the four approaches in both centralized and decentralized configurations. For each approach, we have further selected vendors as illustrative of the costs for the selected machine size. We are not committed to any vendors in any way. The ones which were sampled have good reputations and readily available price information. Details of these inquiries are in Appendices D and G. The various factors which are required to determine the total monthly cost of each basic approach are summarized in Figure III.C.1. An attempt has been made to take into account everything that will contribute to the cost of operating the new machines. An attempt was also made to cost each approach with the same accuracy, that is, unnecessary capacity was not put in some configurations while trimming others to the bare minimum. Two generalizations appear from Figure III.C.1. The more interactive the system, the greater the cost. And for any given level of interaction, a centralized configuration is clearly cheaper than a decentralized configuration.

Figure III.C.1 contains, besides operating costs, a qualitative estimate of programming development cost. Each of the configurations shown in III.C.1 was compared with each of the others with respect to estimated programming development costs, and was rated as highest, higher, middle, lower or lowest. Some configurations closely correspond to configurations supported today by existing data base/data communications program packages. Taking an existing package and making the modifications necessary to suit our needs could reduce programming costs by half. But for now, the estimate of development costs for those configurations that might use existing data base packages has been made as if no package could be used. Thus, a configuration rated as having high programming costs could have the lowest, if it were found that an existing package would be of help.

FIGURE III.C-1
University-Wide Monthly Costs

	Batch Update					On-line Update					
	Batch		Inquiry			On-line Queue			On-line Update		
	Local	Central	Local	Central & Local	Central	Local	Central & Local	Central	Local	Central & Local	Central
Hardware	74,200	29,000	99,000	31,600	31,600	143,600	45,900	65,000	151,700	65,000	65,500
Support Equipment	5,200	900	5,200	900	900	5,200	900	900	5,200	900	900
Communi-cations		4,400	500	5,300	5,300	600	5,500	5,500	600	5,500	5,500
Physical Plant	1,100	500	1,100	500	500	1,100	500	500	1,100	500	500
Operating Personnel	27,100	23,200	35,300	15,800	15,800	35,300	23,600	15,800	31,400	15,800	15,800
Supplies	9,000	9,000	9,000	9,000	9,000	5,000	5,000	5,000	5,000	5,000	5,000
TOTAL OPERATIONAL COSTS	116,600	67,000	150,100	63,100	63,100	190,800	81,400	92,700	195,000	92,700	92,700
Program Development	Lowest	Lowest	Lower*	Middle	Lower*	Middle	Highest	Higher	Higher*	Highest*	Higher*

*Possible use of existing data base software packages.

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III.D. Advantages and Disadvantages

The advantages and disadvantages of all the possible alternatives for Order and Standard Loan automation really boil down to three major considerations: cost, service and expandability. Sub-issues raised under cost are replaceability (which costs in a manual system are replaced?) and growth (which way provides the most options so that a lot is not spent later on redirection). Sub-issues under service are the availability and reliability of the system, the currency of the information provided by the system, the delay time in getting current information if it is not already available, the flexibility of the system for handling all the different procedures of the various libraries, and the management control of the production operation. Expandability refers to the equipment's ability to handle an increased work load or new functions in the future.

With the Batch approach, the hardware costs and development costs are less. But the number of manual operations replaced is also less than with the on-line approaches. The sum of manual and machine costs may be just as great using the batch approach as with the on-line approaches. A cost argument for the batch approach is not strong. From a service standpoint, the batch system is confronted with the problem of keeping information current. This is especially true in circulation where data changes rapidly. Batch circulation requires manual assistance to keep information current, with two consequences. The manual assistance adds more costs. And, in order for people to be of assistance, records must be not only machine readable, they must be human readable, which means, more likely than not, using punched cards. It is very hard to escape use of the punched card as a book card, and book cards are not popular with some librarians. Furthermore, UCLA, in a well thought-out paper (Reference 39) specified many highly desirable requirements for a circulation system, and these requirements could only be satisfied by an on-line updating type of system. If it is at all feasible from a cost standpoint to implement an on-line system, we must view it as desirable to the librarians to do so. Hence, the batch approach must be regarded as a less satisfactory approach to order and standard loan library automation.

The inquiry approach, being a more expensive form of batch updating, has weaker cost justification merits than the pure batch approach. And, since it has all the same problems of keeping information current as the batch approach, it should definitely be regarded as less satisfactory than batch.

This leaves the two on-line approaches as the prime candidates to provide the service desired by the librarians. To the user, these two systems are equivalent. The availability of order and circulation information, and hence the service provided, is the same for both. The deciding factor in choosing between them is going to be cost. Libraries are constantly acquiring more information from vendors about prices and capabilities of their products. They have hopes of finding cheaper ways of providing the desired level of services. But for the present, the cheapest configuration identified is one having a single large central machine linked to smaller processors on each campus which share the workload with the central machine. It is the on-line queue approach using local processors. This configuration, besides being cheapest, provides two levels of hardware back-up. If the central processor fails, the local processors can continue to accept all new transactions and most inquiries. If the local processor fails, all the loan terminals and some order terminals will have a local mode of operation in which transactions are stored on tape cassettes until such time as the local provessor becomes available. This configuration also has the advantage that it could be easily expanded at the central facility to handle the large data base research work being done by the Institute of Library Research.

Additional important advantages and disadvantages of the various approaches are detailed in Appendix D.

III.E Recommendations

It has been clearly established by our analyses that total operating costs are less for systems with central machines and that for some operations librarians will define requirements that demand on-line access to computer files. Our search for the most economical and effective approach will continue as new information and considerations are presented by anyone who is interested. However, it would appear now that on the basis of machine costs alone, central computer arrangements must be selected over nine autonomous computers in the libraries at each of the campuses. Further, with some care, it should be possible to provide with a central machine most of the benefits usually associated with "having your own computer".

The most sensible course of action now is to find the best and least costly machine that can handle the needs of the libraries in the immediate future. The search for a machine should take cognizance of existing facilities within the University. The UCB 360/40, the ADP 360/65, or machines possibly available in other locations would handle our needs for at least five years. Any of these machines probably would be cheaper than the equivalent machine brought in on a new lease or purchase. The libraries could negotiate to acquire or use one of these machines. Appendix D.6 and G.5 document the savings for utilizing the 360/40 or the 360/65. For example, if the 360/65 could be acquired for the central facility, the total monthly costs for the On-line Queue approach would drop from $81,400 to $78,500.

IV. SERVICE BENEFITS

IV.A. Summary and Conclusions

The concern of this section is "total library effectiveness". This term stands for the sum of all efforts needed to put a library patron is possession of all the information he seeks; in this sense, "total library effectiveness" subsumes all costs and services contributing to the library's operational goals. Insofar as libraries exist solely to provide service to their patrons, library effectiveness is the library's goal.

The main thrust of the UCLSD Program is based on the premise that the application of certain technological advances to the University libraries will enhance the effectiveness of those libraries. To support this premise, it was first necessary to determine if an actual need for improvement exists, i.e., it was necessary to measure the present performance of libraries to know what level of effectiveness is necessary and/or optimum to support University goals. Second, it was necessary to define ways in which it is likely that automation will increase library effectiveness through design and implementation of library systems.

Measurements of present performance are reported in Part C of this section. The major evaluation was obtained from a survey of the members of the University community. Results of this evaluation show that less than 65% of the respondants gave library performance a high rating in response to more than half of the questions concerned with specific aspects of library use. At the same time, sharply critical responses were in the minority and only three aspects of library performance invoked sharp critical ratings from more than one third of the respondants.

These user ratings of library effectiveness provide neither a "mandate for improvement" nor grounds for satisfaction. They do indicate that the libraries are unable to meet the performance dictates of many users in specific cases and that the library's ability to support the goal of excellence in teaching and research is less than optimum.

In Section D, it is shown that by making use of electronic data processing in their operations, the libraries of the University of California could more effectively provide the material needed by a user when he needs it, could maximize the amount and quality of information received with minimal amounts of time and effort for the user, and could have the facilities available for more effective library management. That is to say, automation provides the capacity for improved performance. Disregarding the possible cost of such improvements, the essential desirability of library effectiveness benefits emerge over and above library cost considerations discussed elsewhere in this document.

Section IV.E. discusses the possible benefits to other libraries in California and nation-wide. These benefits would result from the new methods and outputs resulting from the University of California Library Systems Development Program.

It is impossible to place a dollar value on all of the service benefits of the proposed program. However, since these benefits represent the basic goals of all libraries, increased service benefits are certainly desirable, even without considering possible cost benefits discussed in Section V.

IV.B Introduction

IV.B.1. Recent Efforts

Employing the task team approach, a group of UCLSD Program staff members and campus systems office personnel conducted and analyzed the results of a literature search. This analysis is summarized in Appendix H (an adaptation of Reference 24, pages 22-25 and a reconsideration of Reference 45). On the basis of this study, two user surveys were identified as likely vehicles for the measurement of existing library effectiveness; the first of these was a Document Delivery Test and, the second, a library user survey discussed in Section IV.C and Appendix J.

IV.B.2. The Practice of Effectiveness

The men and women who administer the libraries of the University of California, while constantly aware of the need to enhance user satisfaction, have set up realistic guidelines for meeting the needs of the major portion of their users. Complexities, such as incomplete knowledge of user needs, conflicting priorities in user demands, realistic possibilities in funding and subjective evaluation, have precluded the adoption of simplistic methods. Thus, while user demands and needs are potentially boundless, library funds and talents are far from boundless. The practice of making a library effective has been the process of resolving these conflicts.

There are many elements in the current library picture which will contribute further to these present complexities. The increasing staffing costs will make increasingly large demands on library budgets endangering present service aspects and book budgets. There will be an expanded user base if the University communities continue to increase. In addition, although traditionally oriented toward student and faculty needs on specific campuses, librarians are being asked to consider service to students on other campuses as well. The Governor has indicated* that the University Libraries, as educational resources of the State, might extend their services to an even broader state-wide clientele.

It has been obvious in many of the University program revisions, that heavier demands will be made on the library by the present user population. Increased user awareness of the potential power of the computer in the area of information retrieval and a generally better informed academic community can be expected to maintain, if not increase, its demands on the information gathering powers of the University Library systems.

IV.C. Analysis of Current Manual Systems

IV.C.1. Conclusions of User Studies

Two tests for evaluating the current performance of UC Libraries were made during the Feasibility Phase. The first test was conducted on an experimental basis at the nine campuses. It attempted to provide a quantitative and objective measure of patron success in getting needed material from the library. It covers only one aspect of library performance and, thus, does not serve very well as an evaluation of a multipurpose operation.

An evaluation of a broader range of library operations was sought in a second test conducted duirng the month of February. The results of this test are detailed in Appendix J. A large sample of the libraries' users were asked to complete a questionnaire on their attitudes and expectations regarding the library. They were specifically asked to indicate their degree of success or failure in using various library services. Survey responses were classified according to a user's indicated degree of satisfaction with library services (high, low, middle). The results of these questionnaires were evaluated campus by campus and it was discovered that no campus rated uniformly high or low in terms of its users' satisfaction. While these results are useful to the individual campus libraries in determining areas of service which may need further study, they do not explain the overall lack of positive response which we obtained from library users.

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*See quote from Governor's Budget in Section IV.E.

The University library users have few alternatives when they encounter a particular deficit in the library system. The weakest link in that system may cancel many other strengths. For instance, the timely purchase and useful cataloging of a book is wasted if the book is unavailable at time of need because of a weak hold/recall system.

The fact that only 60% of the survey respondants could state that they usually or always find materials they need -- when they need them -- does not suggest an optimum return on University's investment in skilled staff and extensive collections.

IV.C.2. User Study

In the user survey documented in Appendix J, each library user in the survey sample was asked 17 questions concerned with his success in using library resources to meet particular needs and with his personal evaluation of specific resources and services. The actual number of responses to a given question was controlled by its relevance to a particular user or by his own knowledge and ways of using the library. Thus overall responses were sharply influenced by the needs and perceptions of students, who are the largest segment of the user population; specifically, by the perceptions of users at the largest campuses. Further analysis of the survey data is required in order to determine the relationship of the ratings discussed in this section to the various groups of library users (See Appendix J, Figure J-8) to the expressed needs of users, and to their patterns of use.

Summary tabulation of the responses to evaluative and priority-setting questions is given in Figure IV.C.1. with the computer print-out being found in Appendix J.9. In general the responses indicated that the order and circulation functions are the sources of the extremes (both the highest and lowest) in degree of user satisfaction. The libraries' performance in managing the quarterly acquisition and transfer of course reserve materials (Question 36) and in maintaining an acceptable queueing rate at the loan desk (Question 32) received the highest percentage of "favorable" responses. At the same time, the time lag in interlibrary loan service (Question 25), and the response to book hold requests (Question 34) were included in the group of services considered least satisfactory. In addition, dissatisfaction was indicated with the libraries' order functions, with 30% of the users reporting that they never, or rarely, see new materials when they look for them. Unsatisfactory or slow response to purchase requests and departmental orders was indicated by half of the respondents for whom this question was applicable.

Responses evaluating the library collections, outside the scope of the Library Systems Development Program, fell

Figure IV.C-1

ALL CAMPUSES-USER SUCCESS/SATISFACTION RANGE

		RESPONSES		HIGH (1)		MIDDLE (1)		LOW (1)	
	Question	# Rec'd	%(1)	# Rec'd	%(3)	# Rec'd	%(3)	# Rec'd	%(3)
22	Collection Quality	1425	87.9	886	62.2	449	31.5	90	6.3
21	Collection Quantity	1437	88.3	763	53.1	528	36.7	146	10.2
23	Index/Abstr. mat'ls	1306	80.6	908	69.5	318	24.3	80	6.1
24	Extra-curric. mat'ls	1266	78.1	830	65.6	318	25.1	118	9.3
27	Success in obtaining new materials	987	60.9	251	25.4	437	44.3	299	30.3
36	RBR books ready on time	1202	74.2	1009	84.0	-	-	193	16.1
43	Dept. book order response	142	8.8	18	12.7	57	40.1	67	47.2
34	Response to hold requests	857	52.9	237	27.6	383	44.7	237	27.6
35	Overdue notice accuracy	741	45.7	504	68.0	125	16.9	112	15.1
32	Chargeout wait	1527	94.3	1244	81.5	233	15.3	50	3.3
25	Interlibrary Loan Service	531	32.8	47	8.9	273	51.4	211	39.7
26	Success in obtaining materials when needed	1550	95.7	975	62.9	468	30.2	107	6.9
28	Success in identifying branch location of book	1510	93.2	1075	71.2	350	23.2	85	5.6
29	Reference Service help	1308	80.7	1021	78.1	238	18.2	49	3.7
30	Subject catalog	1526	94.2	1215	79.6	232	15.2	79	5.2
31	Book description	1485	91.7	862	58.0	419	28.2	204	13.7
38	Purchase suggestion response	216	13.3	22	10.2	74	34.3	120	55.5

(1) How High, Middle and Low was applied to the various responses of the questionnaire is shown in the chart of Appendix J.2.

(2) Percentage of individuals in the sample giving an evaluative response to the question; the percentage excludes "non-applicable" and missing responses.

(3) Percentage of individuals who gave an evaluative response in this range.

Figure IV.C.2

ALL CAMPUSES-USER PRIORITY RANGE

BUDGET LEVEL: + $100,000	(90.5% Response)			
Alternative	Cost	No.	Adj. Freq.%	Rel. Freq.%
(+)				
46 Increase purchases 5%	$+45000	795	54.2	49.1
55 Increase opening hours	+30000	693	47.3	42.8
45 Increase purchases 10%	+90000	632	43.1	39.0
52 Speed new book processing 5%	+20000	584	39.8	36.0
53 Add to Reference staff	+25000	443	30.2	27.0
49 Speed up loan desk	+15000	391	26.7	24.1
51 Speed new book processing 10%	+40000	283	19.3	17.5
(-)				
54 Cut Reference staff	$-25000	131	8.9	8.0
50 Reduce subject indexing	-10000	79	5.4	4.9
56 Decrease opening hours	-30000	88	8.0	5.9
48 Cut purchases 5%	-45000	13	.9	.8
47 Cut purchases 10%	-90000	5	.3	.3
BUDGET LEVEL: No New Funds	(65.3% Response)			
(+)				
58 Increase purchases 5%	$+45000	557	52.6	34.4
67 Increase opening hours	+30000	225	21.3	13.9
64 Speed new book processing 5%	+20000	134	12.7	8.3
61 Speed loan desk	+15000	120	11.3	7.4
65 Add to Reference staff	+25000	79	7.5	4.9
63 Speed new book processing 10%	+40000	67	6.3	4.1
57 Increase purchases 10%	+90000	42	4.0	2.6
(-)				
66 Cut Reference staff	$-25000	594	56.1	36.7
68 Decrease opening hours	-30000	491	46.4	30.3
62 Reduce subject indexing	-10000	385	36.4	23.8
60 Cut annual purchases 5%	-45000	122	11.5	7.5
59 Cut annual purchases 10%	-90000	33	3.1	2.0

in mid-rank of ratings expressing a high degree of satisfaction with the libraries. However, the priority rankings allowed in the second part of the questionnaire show that the largest group of respondents to this section place an increase in book purchases in strong first and third places, above service-related functions. Tabulation of responses in this section is shown in Figure IV.C.2. It should be noted that considerable further analysis is necessary in order to make effective use of the information provided by this section of the survey, since none of the attributes of this group of respondents has yet been tabulated. An increase in library opening hours, also outside the Program scope, is given second place at both budget levels in this section's ranking, although choice of this alternative drops sharply in the absence of additional funding. Further summary, and the initial tabulation of data discussed in this section may be found in Appendix J.

Tabulations of returns for each of the campuses were examined to determine the extent to which the replies from the larger campuses, or from campuses with other peculiar conditions, may have skewed the overall response. It was not possible to achieve consistent campus rankings by various campus and library attributes although several expected biases were found. For example, Berkeley and Los Angeles students are least successful in identifying the branch location of a book, and San Francisco students were most critical of their library's book resources in relation to extra-curricular interests. Summary tabulation of the ranking patterns may be found in Appendix J-11. Use of various libraries in the University of California system in part D are tabulated in Appendix J-10.

IV.D. The Analysis of Increased Effectiveness in an Automated System

IV.D.1 Introduction

There seems to be little doubt in any librarian's mind that automation can improve the ability of a library to serve its users. Whether automation is the best way of increasing effectiveness in a time of increasing demands with possibly decreasing resources has not always been wholeheartedly answered in the affirmative by the librarians. Librarians have brought up the crucial questions of cost and the upheaval incurred in rethinking the total application of staff to library operations. Even without wholehearted assent to a total system development, however, the University librarians have automated functions and services where the effectiveness benefits have appeared to be worth the cost or where there seemed to be no other solution to the operational problems encountered. This section has been prepared to support the premise of the UCLSD Program that automation is indeed the best method to increase effectiveness. Because library personnel have already accepted this premise in part, this section merely re-iterates some of the specific ways in which automation can benefit library operations in the areas of processing, service and administration. It will also consider how automation will provide operational advantages not feasible or possible in manual systems.

IV.D.2 Processing

Processing encompasses the following subsystems: (2.0) Request, (3.0) Source Selection, (4.0) Bibliographic Searching, (5.0) Bibliographic Record (Cataloging), (6.0) Order, (7.0) Accounting, (8.0) Auxiliary Source, (9.0) Book Preparation, and (10.0) Process Monitoring and Control.

In the past, the processing functions of libraries have been the most attractive areas for automation. Across the country, libraries have found that the repetitive clerical tasks can effectively be accomplished by machine, often using techniques developed and tested in other business applications. With automation, benefits include reduced elapsed time to process bibliographic records, accuracy, availability of records (to staff and patrons), and provision of data (statistical and substantive) upon which collection activities can be based.

With automation,processing time (of library materials) will be speeded up because data can be processed more rapidly, thereby increasing the amounts of data that can be handled without large increases in personnel. With better in-process control, excessive backlogs can be pinpointed and efforts made to eliminate them. Vendor analysis produced automatically (which is manually not cost effective) provides the information needed to select vendors on the basis of rapid and accurate responses to requests. Automatic follow-up on orders, requests, and failure of receipts can be made more effectively by machine, as within a manual system this is often greatly dependent on workload and is thus not consistently done. Adequate follow-up on Serial receipts is likewise not cost effective currently but is extremely desirable to reduce the need for obtaining serial material which is out of print. Flow of materials can be facilitated by provision for automatic routing procedures.

Entering bibliographic information into the machine record on receiving a request for material or the material itself, will prevent loss of records, will make available an in-process record for the patron as well as the library staff, will eliminate errors generated by rekeying and refiling, and will help in avoiding duplication. This type of control would currently require an increase in manhours that cannot be cost justified. In addition, a bibliographic record captured and revised at the first verification will eliminate multiple searches and refilings.

When a fully automated catalog is implemented maximum use will be made of national machine readable data bases such as the Library of Congress MARC II file. Eventually, and in desired areas, material can be analyzed to a greated depth of subject description.

Particularly on large campuses, subject, author and agency authority control information tailored to local activity should facilitate the cataloging of books. Because of the high demand for improved subject authority control on some campuses, this has been chosen as one of the initial UCLSD Projects and is currently in progress.

The bibliographic record, made available to the patron, can indicate to him the status of his request at any time, as well as providing a projection of when material will be available for his use. Knowing that the library is not always to blame for long delays in obtaining his material should greatly improve patron-library relations.

The bibliographic record with its complete ordering and cataloging data fields can make possible a multiplicity of approaches which at present require or would require setting up multiple files with their inherent difficulties. By subject manipulation of receipts, both the patron and library collection builder would have greater knowledge of content of new collection entries.

Immediate and accurate information on funds readily can be provided in an on-line automated system. Administrative decisions in collection development will be facilitated by up-to-date funding reports.

Greater accuracy in accounting methods is expected through automation thereby eliminating some of the present time consuming problems of invoice handling.

Shared knowledge of University-wide collection building through readily available accession lists ultimately could make collection decisions less costly.

Obviously the compilation of statistics and statistical reports in processing can easily be provided by mechanized systems to be used in management decisions at all levels in the library.

On the basis of this discussion and on the basis of the analysis in Appendix K.2, it is concluded that automation of processing will benefit libraries in the following ways:

(1) Processing time will be shortened (that is, the patron should more often be able to find new materials when he wishes them).

(2) The patron will have a better understanding of reasons for failure to find new material when he looks for it (not yet published, publisher out of stock, etc.).

(3) There will be greater accuracy and control (resulting in duplication avoidance).

(4) There will be greater flexibility in manipulation of the data on the in-process record providing more information, both substantive and statistical, to librarian and patron alike.

(5) There will be better follow-up in a range of areas: monographic receipts, serial receipts, invoices, out-of-print requests, etc.

(6) Vendor analysis will be possible providing wiser vendor selection and better relations.

(7) The patron will have more information in a more usable form regarding library receipts.

(8) An automated system will be more flexible in providing for variations in work load.

IV.D.3. Services

Service subsystems include (11.0) Standard Loan, (13.0) Stack Control, (14.0) Information Retrieval, (16.0) Patron Services, and (17.0) Services Quality Control.

Although both processing and administrative functions ultimately aim at service, in this section only that which is directly involved with service to the patron will be considered.

The UCLSD Program has two projects in process that have proven the value of automation to services. These are the Union List of Serials (ULS) and the Union Catalog Supplement (UCUCS) Projects. Automated serials lists have provided effective to users to such an extent that eight out of the nine campuses already have machine produced lists, if not completely automated systems. Within the scope of the current ULS Project, the user will have access to titles, locations and holdings information of University-wide serials collections.

The utility of the Union Catalog Supplement already has been tested by the Berkeley and Los Angeles catalogs which it supplements. With the inclusion of the other campus holdings, the supplement benefits should be greater both in terms of knowledge of holdings and in providing a data base for use in cataloging.

Various campuses have already shown that computer produced bibliographic files can be manipulated for increased user access. In some areas such as maps, only machine manipulation of the data bases can adequately provide the needed information about material for the user. In a period of increased demands of professional reference staff, automation can greatly aid library effectiveness by providing retrieval and index devices allowing the librarian to more quickly assist the user in finding material and information. A user's time is very valuable (to him) and mechanized systems will conserve his time. The projected Standard Loan Subsystem, for example, will reduce from over one and a half minutes to about fifteen seconds per book, the time it takes to check out a book. With well over five million circulation charging transactions occurring each year, this amounts to 110,000 hours of user time saved and while few users are paid to use the library, the equivalent "cost" of this time is not insignificant. If the 4.4¢ per minute of productive student assistant time (See Appendix S.3.B.) is used as a measure of value, the "cost" of student time saved by a mechanized circulation system would be about $290.000 per year.

IV.D.4 Administration

Included in administrative subsystems are (1.0) Collection Development, (18.0) Fiscal, (19.0) Personnel, (20.0) Supplies and Equipment, (21.0) Physical Plant and Facilities, (22.0) Library Documentation, and (24.0) Organization and Policy.

Automation will facilitate the administration of libraries by providing better management records upon which to base administrative decisions. In the original systems definition, the administrative subsystems were defined in terms of control, for certainly it is in terms of control and consequent information availability that automation can most effectively be applied to the administration of libraries. More sophisticated use of the machine will undoubtedly go beyond these primarily clerical and information producing operations.

Statistics for budget preparation can more readily be collected and compiled in automated systems as a byproduct of other functions. They can readily be analyzed and displayed so that past expenditures are more clearly understood and requests for future funding are more completely and accurately verified.

Personnel records in large industries have long been maintained by machine with timekeeping and payments managed by machine. Even with present staff levels, particularly in the area of student employees (whose time may change every month), the treatment of payment records by machine could facilitate timekeeping, payment, and leave time records. Data processing sheets from Central Accounting already provide monthly information on status of library funds; with internal data processing, the libraries would have much more complete and useful statistical data on personnel funds.

Personnel training will be affected by automation, for the procedures for handling machine inputs and outputs will have to be carefully documented, providing a ready-made tool for training personnel. With mechanized procedures replacing some of the old manual procedures, turnover and the training caused by it will become less important.

Information on staff members' specific skills readily available in machine form can aid in making better use of talent available. Manually prepared, this kind of service would be impossible to keep up-to-date.

As with personnel records, supplies, equipment and building use can be readily controlled by machine and thus make possible more sensitive response to needs in these areas.

Management of books funds and therefore collection building decisions, because of the large amounts of money involved and the central position and importance of collection development in making the library an effective organization, are major administrative functions in the library. Automation can provide vast quantities of information in usable form so that administrative decisions can be based, not only on experienced intuition but also on the best available information as well.

IV.E. Other Benefits

The University of California has had a long reputation of being in the forefront of intellectual achievement. The libraries have been no exception to that statement. Now, with the combined efforts of librarians and systems personnel the UC Libraries will have a further opportunity to contribute to the advancemenet of library systems throughout the country. The example of the UCLSD Programs' methods, approaches, prototypes, problem solutions and the outputs of the new systems developed should assist and benefit other institutions in the United States just as the UCLSD Program has benefited from the work of the Library of Congress, Cornell University, Stanford University, Massachussetts Institute of Technology, individual University of California campuses, and other institutions.

With regard to the University's library responsibilities, the Governor's Budget states:

> While the primary purpose of the library program is to support the teaching and research programs within the University, it also serves other elements of the community. Any adult citizen of the State with legitimate need is permitted access. The libraries also are engaged in active service to all of higher education in the State and any teacher in higher education, public or private, may be granted borrowing privileges.

Because of different user populations and goals, the UCLSD Program cannot serve as an exact model for other state systems such as the State Colleges; nevertheless, it could serve as a guide to help them develop their own systems if they so wish.

The UCLSD Program could increase considerably the effectiveness of other libraries and other library systems in the State of California. Many of the tools and products developed by the Program could be used directly by other libraries as suggested below:

BIBLIOGRAPHIC ORGANIZATION AND CONTROL:

1. Availability of the University's Union Catalog Supplement and Union List of Serials, both in printed and machine readable form, will be of immediate use, and should reduce perceptibly the time spent at the State Colleges in doing original cataloging.

2. For smaller public educational institutions, particularly for the Junion College System, access to the University's union catalogs can replace the need for more expensive search tools.

3. As mechanized State College library systems are developed, some of the control tools developed for the UCLSD Program (e.g. cumulative LC authority list) will be immediately useful regardless of system differences, just as LC control tools have been infinitely useful to institutions across the country.

BOOK ORDERING AND SELECTION:

The analytic and report capabilities (vendor performance evaluation, user and requester evaluation, book cost data, collection additions profiles) to be developed under UCLSD are directly useful to public college acquisitions planning.

INFORMATION RETRIEVAL:

Copies of tape files developed or maintained by the Center for Information Services (CIS) (part of the UCLSD Program) can be used by a parallel State College facility. Alternately, it is probable that it will be beneficial to the State College system to contract for CIS services rather than to develop and operate its own system.

EQUIPMENT PURCHASING INFORMATION:

Selected reports from UCLSD's Equipment and Supplies Subsystem will provide directly useful purchasing data for other California libraries, e.g. equipment downtime, maintenance cost records, optimum inventory levels, etc.

DIRECT SERVICE:

Increased knowledge of location will greately facilitate Interlibrary Loan for libraries of smaller institutions throughout the State (Union Catalog Supplement and Union List of Serials providing the information).

V. COST BENEFITS

V.A. Current Costs

V.A.1. Cost Study Results

In order to demonstrate cost benefits for automated Order and Standard Loan functions, we must first determine what these activities now cost in terms of labor. Then we must calculate the impact of automation on the amount (and cost) of the labor required to perform these activities. The net cost benefit will be the cost of labor saved less the cost of operating the computing equipment required for automation. We are assuming that there will not be a significant amount of non-labor savings (p. 97, Reference 24).

The concept of cost benefits is complicated by three potential questions which can carry a high emotional charge:

* What do you do with the labor you save?
* What about the initial cost of developing a system and buying a computer?
* What about all the extra things you can (and will) do when you have a computerized system?

These are extremely important considerations. However, from the standpoint of this section, they are irrelevant; they should be considered as trade-off factors after cost benefits have been calculated. All we are concerned with in this section is the cost of doing exactly what we do now, but doing it with computers.

We attempted to measure the actual labor costs of performing the Order and Standard Loan functions for all of the University libraries. At every library unit on each campus, all of the people whose jobs contribute directly to the accomplishment of these functions participated in a five-week work-measurement project. The UC Library Systems Task Force had already developed a breakdown of library operations into "Subsystems" and "Modules". Modules were intended to be functional , independent of system concepts or types of material handled. (See Appendix N.) For purposes of this study, we broke each module in the Order and Standard Loan Subsystems into its component "Tasks". Each day, every person involved in the cost study recorded on a time sheet the amount of time he spent on any of the 83 defined tasks.

In order to measure unit module costs, it is necessary to measure output in some manner. We selected one or two task-associated quantitites in each module as being a reasonable measurement of output for the whole module; for these tasks, quantities as well as times were recorded on worksheets. Examples of such quantities are "number of notices sent out", or "number of invoices processed". (For a detailed discussion of the problems of task selection and measurement, see Appendices O and R.)

This is what we found. The period during which our measurements were made was reasonably typical for the year (Appendix S). Despite significant errors made during the first two weeks of the study, the measured costs were reasonable and fairly consistent from one week to another as shown in Figure V.A - 1. During the first two weeks, some of the participants counted the number of orders placed more than once so that the unit costs calculated for order initiation were somewhat too low. Most of these errors were corrected. As far as we could tell, there were no serious errors in the data for order receiving or standard loan operations.

The average cost to the library for ordering a book was $1.37 (based on data from the first four weeks). The average library cost for each item received was 38¢ (four weeks average). It cost the library an average of 30¢ per item circulated (four weeks average). When other non-library overhead costs to the University are added (Appendix Q), these costs increase to $1.69, 47¢ and 37¢ respectively.

Detailed cost information for each of the modules included in the three library activities are presented in Appendix X. The costs measured for each of the tasks in a module also are presented there. A summary of the actual time and quantity data reported for each week of the cost study is presented in Appendix L.

The people participating in the cost study were spending considerable time on library work in no way related to the ordering and circulation of books. In fact, about 40% of their time was spent in this way during the study. Another 10% of their time was spent taking vacation, being absent on sick leave, etc. (non-production oriented activities). About another 10% of their time was spent on supporting tasks such as timekeeping, meetings, etc. Of the remaining 40% of their time, approximately 5% was spent for Order Initiation, 10% for Order Receiving, and a little less than 25% for circulating books. These percentages varied somewhat from one week to another, but these values are representative.

To make the overhead calculations simpler, we grouped all job classifications into one of four categories: Administrators, Professionals, Clerical, or Students (Appendix Q). The time reported (during the first week of the study) was distributed as follows:

FIGURE VA-1

Cost-Time-Quantity Measurements
Observed During Cost Study
(MAIN and SECONDARY)

COST CATEGORY	MEASURED WEEKLY VALUES Week 1	Week 2	Week 3	Week 4	Week 5	Avg Wk
ORDER INITIATION (Mods 6.2,6.3,6.6,6.7)						
1. Labor-Man Hours	2708	2746	2790	2680		2728
2. Labor Cost-$	14676	14888	15096	14425		14771
3. Titles Ordered(6.2)	10957	10869	10143	11201		10793
4. Man Hours/Title	.247	.253	.275	.239		.253
5. Cost/Title	1.339	1.370	1.488	1.288		1.369
*6. Burdened Cost/Title	1.658	1.695	1.842	1.594		1.694
ORDER RECEIVING (Mods 6.1,6.4,6.5)						
1. Labor-Man Hours	4967	5110	5224	4938		5055
2. Labor Cost-$	24229	24628	25252	23771		24470
3. Items Rec'd (6.4)	64099	70834	67679	57519		65033
4. Man Hours/Item	.077	.072	.077	.086		.078
5. Cost/Item	.378	.348	.373	.413		.376
*6. Burdened Cost/Item	.468	.430	.462	.511		.466
STANDARD LOAN (All 11. Modules)						
1. Labor-Man Hours	9925	11552	11522	11497		11124
2. Labor Cost-$	39750	45369	45058	44795		43743
3. Items Charged(11.1)	119169	144054	154681	168946		146713
4. Man Hours/Item	.083	.080	.074	.068		.076
5. Cost/Item	.334	.315	.291	.265		.298
*6. Burdened Cost/Item	.413	.390	.360	.328		.369
SUPPORTING TASKS (Cost Study Tasks 1800-2400)						
1. Labor-Man Hours	4303	2761	3745	3582		3892
NON-PRODUCTION ACTIVITIES (Cost Study Tasks 9901-9910)						
1. Labor-Man Hours	5809	6042	6113	5874		5960
EXCLUDED TASKS (Cost Study Task 0000)						
1. Labor-Man Hours	20307	21488	22222	22035		21513

*Includes 23.75% external overhead rate (See Appendix Q).

CATEGORIES	ALL TIME REPORTED DURING FIRST WEEK	TIME REPORTED FOR ORDER OR STANDARD LOAN
Administrators	7%	3%
Professionals	15%	6%
Clerical	54%	59%
Students	24%	32%

These results are more than just interesting. With more than 90% of the work in Order and Standard Loan being performed by students or clerical personnel, it is implied that much of the work must be fairly routine. It is clear why mechanization offers the greatest potential for cost benefits in these areas.

V.A.2. The Sample Period

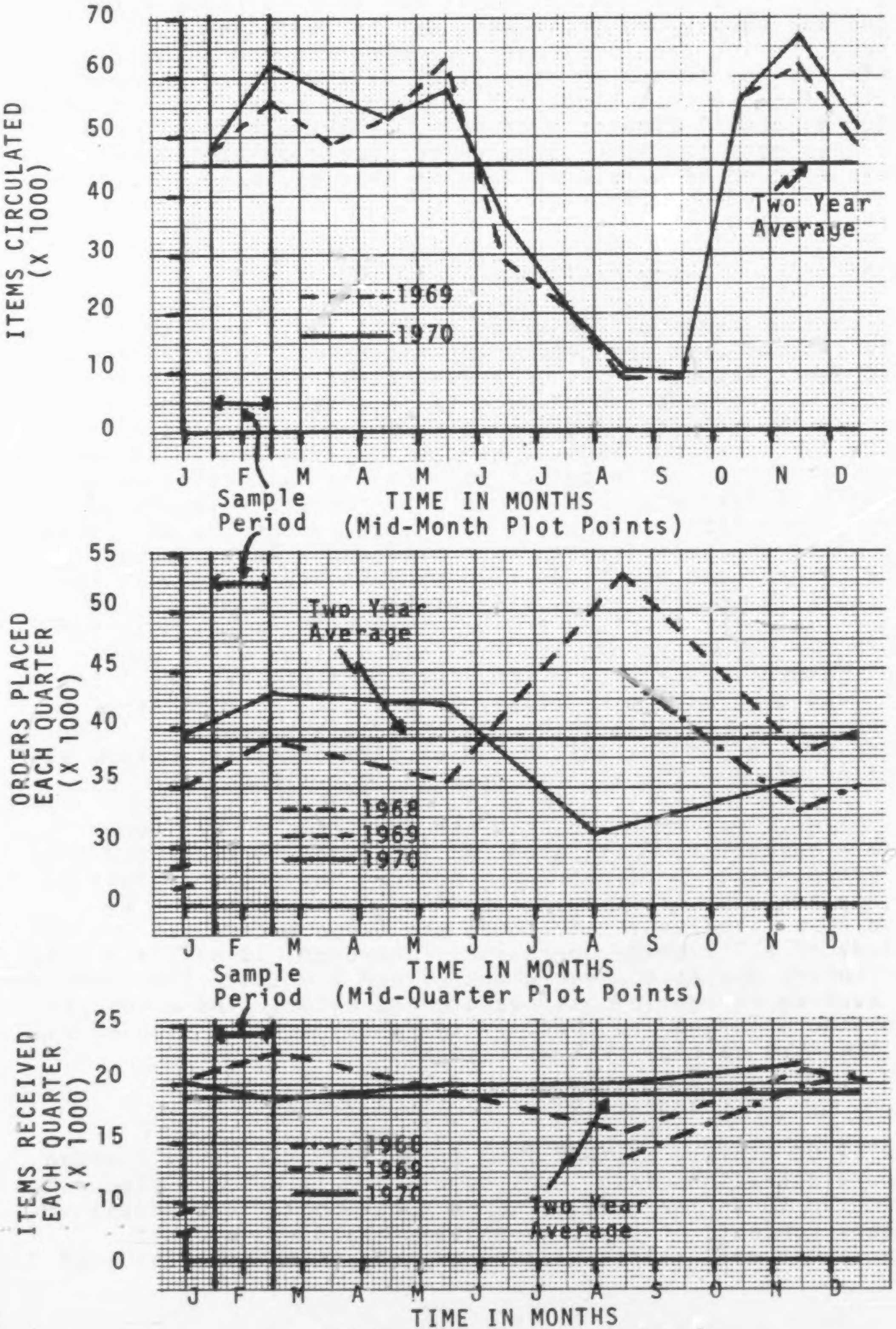
We knew that the sample period, which ran from 11 January 1971 to 14 February 1971, might not be a typical period. So, we looked into the possibility of annual variations in workload. What we found is shown in Figure V.A-2. During the sample period, it appears that the circulation rate was on the order of 20% higher than the annual average. Some of the reasons for this are discussed in Appendix M. Reactions from the people who participated in the cost study (Appendix W) indicated that circulation tends to be higher at the beginning of each quarter.

As Figure V.A-2 shows, no such clear cut trend is present for either initiating orders or receiving material. Thus, the assumption that the workloads measured during the study are typical seems justified.

We questioned what impact the hiring freeze might have on the costs we were measuring. The data offered no help here, but we suspect there may have been compensating effects. More highly paid professional and administrative personnel may have chipped in to help out and their higher pay scale would have made the unit costs somewhat higher. On the other hand, the order receiving and circulation workloads are pretty much independent of the number of people available to handle them so that the same workload may have been handled by fewer people, thus lowering the unit costs somewhat.

Appendix M discusses other unusual situations which occurred during the study including the Los Angeles earthquake which all but stopped circulation for a few days and some major collection moves which interfered with normal library

FIGURE V.A-2
ANNUAL VARIATIONS IN WORKLOADS* SHOWN WITH SAMPLE PERIOD



*Data supplied by the UC Santa Barbara Libraries functions. The cost study itself may have had some effect on the way people did their work during the study. For example, during the first week, people reported an average of 52 minutes per person to keep track of their time and production for the cost study (in subsequent weeks, this dropped to 50,43, and 40 minutes average). We suspect that there may have been many isolated cases where people unintentionally either speeded up or slowed down because of their participation in the cost study. However, the data shows no clear cut trends in this regard.

V.A.3. Study Rationale

Various means of measuring current costs were considered. A study using cost accounting techniques was selected for at least four reasons. First, it was necessary to systematically collect an enormous amount of data in a very short period of time and the selected approach appeared to offer the best chance for success. Second, we had very few qualified systems analysts that we could put to work on the collection and analysis of data acquired from a representative sample of UC Library operations. In other words, we needed the additional help which the selected approach provided. Third, comments which we had been receiving from many sources suggested the desirability of getting as many people as possible at the campus libraries involved in the study as early as possible. Fourth, we knew that despite the reservations which many people expressed regarding the study methods that the library staff would be much more likely to believe the results of analyses based on data which they themselves provided than the results of an analysis based on data obtained in some way which might be difficult for them to understand.

An earlier effort to estimate the costs of various library operations (Reference 24) indicated that the ordering and circulating functions would account for possibly half of all replaceable costs for the entire library system. We would have liked to verify those preliminary conclusions with a study of all library operations. However, it was felt that the library operations could not afford the staff time involved for such an extensive cost measurement effort. As a compromise, the ordering and circulating functions were singled out for the more careful cost assessment.

V.A.4 Characteristics of the Approach

The UC Library Systems Task Force had previously divided library operations into "subsystems" and "modules". They attempted to define modules to be functional, independent of systems concepts or types of material handled, and not necessarily reflecting existing organizations or methods of performing the functions that were defined. (See Appendix N). For the purpose of this study, a list of tasks and task-oriented quantities was developed to represent the work currently being performed for those functions included in the definition of the Order and Standard Loan subsystems. (See References 46 and 47 and Appendix N). While much work went into determining which tasks and quantities to measure, and while those selected received extensive review by both systems personnel and librarians at the campuses, we would no doubt make extensive revisions in both lists before repeating the study. The differing operating methods and procedures at each of the various campuses made it very difficult to arrive at a single set of definitions which would adequately describe everyone's operations.

In order to express all of our measured costs in terms of units of production for each of the modules, we had to find a single workload related quantity to use for each module. Most of the time, the quantity that should be selected was reasonably obvious. The problem became particularly acute when we attempted to specify a single quantity for the entire Order Subsystem. We finally decided that it was not possible and divided the Order Subsystem into Order Initiation and Order Receiving. In this sense, two new subsystems were created out of the one. Standard Loan was less trouble in this regard. The costs of this subsystem are expressed in terms of the items charged out or renewed. At the present time, the analysis which led to the measured quantity selections has not been documented. We expect to perform additional analyses as well and when results are available, they will be included in Appendix R to this report.

To get the unit costs for each module, we added all of the time reported by the people participating in the cost study for all of the tasks included in that module. Then, each person's time was multiplied by his "burdened" salary rate (Appendix Q). All of these "burdened" labor costs were added together and divided by the total number of units of the workload quantity reported by the participants to get total labor costs per unit for that module. No other costs were considered because a previous study (Appendix C of Reference 24) showed that other non-labor library costs amounted to only 3.2% of the total costs. Thus, the estimates of replaceable unit costs are conservative to this extent (See Appendix P).

The determination of appropriate overhead rates is described in detail in Appendix Q. The overhead rate is broken into two parts:

(1) Internal Overhead is the rate obtained when a fair share of the costs of the non-productive and supporting

activities is assigned to the productive tasks. The non-productive activities are things like vacations, sick leave, holidays, etc. While the supporting tasks, such as budget development, timekeeping, personnel processing, etc., are certainly "productive" in the most general sense, it is difficult to identify them with the production of any of the units of work which were specified for the Order or Standard Loan subsystems. The assumption was made that time spent on these supporting tasks contributed equally to all of the Order and Standard Loan tasks (this is because the people participating in the study had been asked only to record time against supporting tasks which were in some way related to the ordering and circulation of books). The cost of the non-production oriented activities, on the other hand, we felt should be shared by all of the "productive" tasks whether or not they were in the two subsystems being studied. Thus, the time reported as "other library functions" (Task 0000) was added to the time reported for the Order and Standard Loan tasks and the time for the non-production oriented activities was proportioned among all "productive" tasks.

(2) External Overhead refers to real costs to the University of supporting library personnel, but costs over which the libraries themselves have no control. An overhead rate of 45% is currently used by the University in calculating the cost of government contracts. However, a careful evaluation of the things that were included in calculating that rate (see Appendix Q) suggested that some of these costs would be incurred by the University whether the libraries added any additional staff or not. That portion of additional overhead costs which the University possibly could avoid, if additional library staff was not hired, amounted to 23.75% of the salaries of these people.

Appendix S describes at length the data handling procedures of the cost study. Great care was taken to insure that incoming data was accurate and complete. While many of the people who participated in the cost study commented that much of the data which they individually provided had to be based on estimations, the relatively consistent unit costs observed from one week to another suggests that when all of the estimates from the large number of people who participated in the study were added together, the average value was much more accurate than particular individual estimates. This is illustrated by the data in Figure V.A-1.

For all practical purposes, it is impossible to make a meaningful comparison between the annual statistics which the libraries had been maintaining and the annual values implied by the workloads measured during the cost study. Some of the problems are discussed in Section V.D.3. The historical workload trends discussed in Appendix M summarized what we were able to learn from annual statistics.

V.B Replaceable Costs

V.B.1 Conclusions

Estimates of impactable costs (costs associated with those library operations which would be modified in some significant way by a new mechanized system) were developed in Reference 24 for all UC Library subsystems. These original estimates are summarized in Figure V.B-1. Based on extensive measurements of costs associated with buying and circulating books in the UC Libraries (See Section V.A) together with the detailed assessment of the percentage of existing costs associated with these functions which might be replaced by a mechanized system (see Appendix W), new estimates of replaceable costs (those costs which would be eliminated through the investment in a new mechanized system) were developed for the Order and Standard Loan subsystems. (See Appendix X). The results are summarized by week in Figure V.B-2 for the MAIN library operations (defined in Appendix V).

Serious consideration was given to selecting the "best" weeks from the analysis of the cost data (Appendix S), but this was not done. Instead, the averages obtained from the first four weeks were used (analysis of the fifth week has not been completed). The measured workloads were used to project the annual workloads as discussed in Section V.D.3.

To get a current estimate of total annual replaceable costs for each of the three areas, we assumed our sample period to be typical and multiplied the average weekly values measured by 52. The values obtained are shown in Figure V.B-1. Taken together, the replaceable costs (best estimates) are approximately 31% of the original impactable costs estimated in Reference 24. If that same proportion held true for the other subsystems, the 1970 annual replaceable costs shown in the figure would be obtained. These data are provided only to indicate the rough order of magnitude of potential "savings".

External overhead which the libraries do not control, was included in the values summarized in Figure V.B-1. We want to emphasize that to the costs which do come from library budgets, another 24% was added to reflect real overhead costs to the University for support of library personnel. These additional costs come from other departments outside the libraries as discussed in Appendix Q.

V.B.2 Rationale for Replaceability Analysis

Based on a good deal of conversation with Librarians about what they would like the new systems to do, and ex-

FIGURE VB-1

Estimated 1970 Replaceable UC Library (MAIN) Operating Costs (Based on measured data obtained from the first four weeks of the cost study)

No	Subsystem Name	Orig. Est. Impactable Costs ($1000/yr)	New Est. of Replaceable Costs* ($1000/yr)		
			LOW	BEST	HIGH
6	Order Initiation	769	+30	206	405
6	Order Receiving	1033	-59	263	476
11	Standard Loan	1380	-269	520	1137
4	Bib. Search	668	-63	208	424
5	Bib. Record	546	-51	170	346
9	Book Preparation	291	-27	90	184
21	Phys. Plant & Fac.	240	-22	75	152
2	Request	237	-22	74	150
7	Accounting	232	-22	72	147
8	Aux. Source	202	-19	63	128
14	Info. Retrieval	122	-11	38	77
20	Equip. & Supplies	99	-9	31	63
10	Process Monitoring	91	-9	28	58
13	Stack Control	74	-7	23	47
18	Fiscal	58	-5	18	37
17	Service Qual. Cont.	---	---	---	---
19	Personnel	---	---	---	---
24	Org. & Policy	---	---	---	---
3	Source Selection	---	---	---	---
1	Collection Devel.	---	---	---	---
16	Patron Services	---	---	---	---
22	Library Documents	---	---	---	---
TOT	Total System	6042	-565	1879	3831

* Estimates include both internal and external overhead as discussed in Appendix Q.

FIGURE VB-2

Replaceable Unit Costs for MAIN Operations*
(Using "Best" Estimates of Replaceability Factors)

	Unit Costs - $/Unit					Avg.
	Week 1	Week 2	Week 3	Week 4	Week 5	
ORDER INITIATION ($/Unit)						
6.2 Order Initiation Mod.	0.217	0.231	0.254	0.212		0.228
6.3 Claims Proc. Mod.	0.324	0.294	0.389	0.311		0.327
6.6 Vendor File Maint. Mod.	0.088	0.085	0.102	0.152		0.103
6.7 Want List Proc. Mod.	0.255	0.282	0.080	1.279		0.188
Total Weekly Replaceable ($)	3,204	3,145	3,320	3,147		12,818
Total Titles Ordered/Wk (6.2)	9,657	9,159	8,258	9,273		36,347
Ord. Initiation Cost/Unit	0.332	0.343	0.402	0.339		0.353
ORDER RECEIVING ($/Unit)						
6.1 Surplus Control Mod.	0.050	0.037	0.026	0.071		0.041
6.4 Receiving Mod	0.049	0.050	0.059	0.055		0.053
6.5 Invoice Proc. Mod.	0.276	0.311	0.326	0.316		0.306
Total Weekly Replaceable ($)	3,999	4,261	4,188	3,900		16,348
Total Items Received/Wk (6.4)	45,129	47,621	42,867	37,554		173,171
Ord. Receiving Cost/Unit	0.089	0.089	0.098	0.104		0.094
STANDARD LOAN ($/Unit)						
11.1 Book Charging Mod	0.036	0.036	0.032	0.030		0.033
11.2 Book Discharging Mod	0.030	0.028	0.028	0.025		0.028
11.3 Holds & Recalls Proc Mod	0.109	0.100	0.123	0.134		0.117
11.4 Long Term Loan List Mod	0.015	0.049	0.023	0.194		0.035
11.5 ILL Control Mod	0.076	0.096	0.089	0.074		0.084
11.6 Patron Reg. Maint. Mod	-1.261	-0.968	-1.079	-0.926		-1.057
11.7 Overdue Book Proc Mod	0.301	0.473	0.590	0.460		0.439
Total Weekly Replaceable $	6,458	8,514	8,691	8,652		32,314
Total Items Charged/Wk (11.1)	98,791	119,914	130,690	141,012		490,407
Circulation Cost/Unit	0.065	0.071	0.066	0.061		0.066

* Including Internal Overhead but excluding the 23.75% external overhead.

tensive knowledge of the technology which is applicable to library systems, a very preliminary systems concept was described (Reference 38). While the concept was described in some detail, this was done only to start all UC Librarians thinking along the same lines about the potential of mechanized systems and to permit hardware costs to be estimated. The concepts were based on extensive study of requirements which have been documented such as the requirement for on-line circulation cited by UCSD (Reference 49) and UCLA (Reference 39) and the UCSB requirement for more responsive order procedures (Reference 50). Even more extensive informal discussions with personnel from all campuses influenced the "guesses" made in arriving at a tentative set of concepts. It was clear from the beginning that significant variations from this basic concept would emerge from the in-depth discussions which the initial concept document stimulated among the librarian's from the various campuses. Thus, the concept described in Appendix U must be considered tentative. It would be remarkable, to say the least, if all libraries could agree on such far-reaching ideas at this early stage.

The conceptual evaluation of hardware alternatives presented in Appendix D illustrates the broad range of options available to the UC Libraries. The recommended hardware approach is compatible with the assumed system concept, but significant variations in the concept would be possible with the same hardware. In fact, the assumed system concept with its explicit requirement for on-line inquiry of files implies somewhat more expensive hardware than a simple remote batch processing system. Comments from reviewers of the systems concept are presented in Appendix W. In order to take into account the fact that not every library operation will benefit equally from mechanization, an analysis of organizational differences was conducted. The results, reported in Appendix V, show that 37% of all the library staff which participated in the cost study were in departments (or branches) with order processing operations which were very similar to the MAIN library operation. Further, 62% of the participants were in departments (or branches) with circulation procedures which were much like those used to circulate most of the books in the MAIN library. Some of the same people in the 37% also are in the 62% because 21% of the participants were classified as working in a department with neither an order or circulation operation that was much like the MAIN operations. Finally, just because an employee is working in a department which has order procedures like the MAIN library operation, does not mean that he necessarily performs any order processing tasks - a large number do not.

V.B.3 Limitations and Reservations

At meetings with groups of librarians from all of the campuses (Appendix W), many aspects of the tentative systems concepts were severely criticized. Concern was expressed that no library had ever approached the solution to its problems in this particular way (using "magic wands" and other "gadgets"). Resentment was expressed at the need for detailed cost justification. Some of our advisors expressed difficulty comprehending the full scope of development activities which would need to be undertaken simultaneously. Thus, there were arguments for a much simpler, piecemeal approach to providing new mechanized systems for the libraries. Still, there was also an undercurrent of excitement and optimism. All participants appeared to accept library mechanization as necessary and most expressed a desire to "get on with the job". It was the methods and system concepts which cause most of the consternation, not the idea of mechanization itself.

V.B.4 Replaceability Calculations

Replaceable costs for the MAIN operations (includes all library operations which are similar to those in the main libraries as discussed in Appendix V) are summarized in Figures V.B-1 and V.B-2. SECONDARY operations account for only 13% of the total replaceable costs predicted by our analyses. Consequently, we have not considered the SECONDARY contribution in our analysis of potential cost benefits. This carries with it the implication that it is not economically feasible to automate these operations under the present assumptions.

Order Initiation has both the highest unit cost as well as the highest percentage of replaceable costs. (28% of the current manual costs are estimated to be replaceable.) Another way to look at this is in terms of its portion of all replaceable costs for the two subsystems (6.0 and 11.0). Our studies indicate that Order Initiation accounts for about 21% of all replaceable costs for the two subsystems. If these replaceable costs are equated with a reduced unit cost, then the "savings" would buy an increase of 39% in the number of less expensive units that could be produced by the same staff using the new mechanized procedures! (In other words, if the original unit cost was $1.00 and this was reduced by 28¢, a hundred dollars would buy 139 units at the lower 72¢ cost. The hundred dollars only bought a hundred units at the dollar price and that's a 39% increase. The same argument holds for any starting unit costs)

Order Receiving represents 27% of the total costs repalced for the two subsystems (6.0 and 11.0). Replaceable costs are estimated to be 24% of the current labor costs and this means that an increased productivity of 32% would be possible with the same personnel using the new mechanized systems.

Standard Loan represents 53% of all replaceable costs estimated for Order and Standard Loan together. Of current Standard Loan costs, 25% are estimated to be replaceable and this is equivalent to a 33% increase in workload capacity.

Further analysis is required before estimates can be made with a high level of confidence for the remaining subsystems. Gross estimates were discussed in Section V.B.1. More will be said about the impact on productivity in Section V.D.3.

V. New Costs -- Based on Recommended Computer

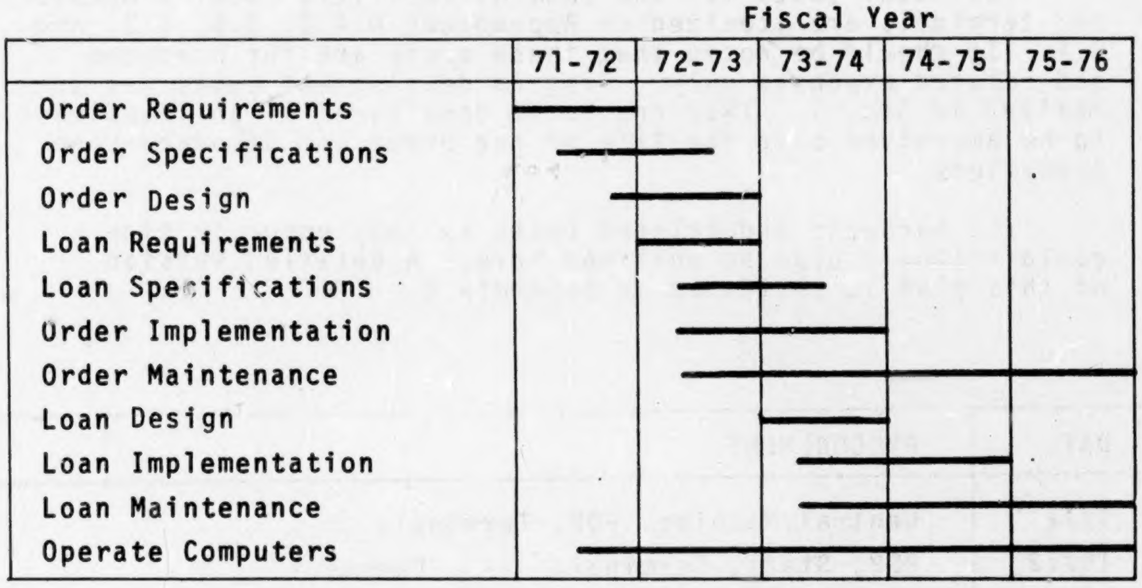
V.C.1 Summary and Conclusion

Computing costs will be incurred gradually as more application programs are developed and more libraries convert to each application. Every new application will be tested by a single unit before releasing it for production use. And then it will be phased in gradually at other locations. This plan minimizes financial outlay, keeps computer errors to a minimum, and gives all the libraries time for conversion planning. The Order Subsystem should probably be developed and implemented before Standard Loan. The experience gained with the Order Subsystem will be valuable to both librarians and developers in their implementation of the Standard Loan Subsystem. Costs would begin about January 1972 and gradually increase up to the maximum of $82,000/month (excluding development costs) in June 1975, at which time all the libraries would have implemented the Order and Standard Loan Subsystems. Development costs are being calculated as a separate investment to be amortized over the life of the Order and Standard Loan Subsystems.

V.C.2 Development Plan

The Order Subsystem is postulated to be developed first, followed one year later by the Standard Loan Subsystem. See (Ref. 1) for a discussion of subsystem priorities. Each subsystem would have to go through the Standard Development Cycle: requirements determination, specification, programming, implementation, and maintenance.

Figure V.C-1: Plan Assumed for Hardware Installation



Note that Order and Standard Loan implementation are estimated to take almost two years each. This is based on the idea that one library at a time will convert to the automated system. It should be possible to work out schedules so that those libraries which are most interested would convert first while those with unique problems or some degree of skepticism would wait until the subsystem has had some time to prove itself.

The central machine and one local processor with two or three terminals would have to be acquired shortly before Order Subsystem programming began. If it had been previously determined that a central machine with remote batch stations was feasible for running existing campus programs, then the central machine could be acquired for the double purpose of supporting existing batch work and Order Subsystem development. They could share the cost. Otherwise, the total cost of the central machine would have to be allocated to the development of the two subsystems. Once the central machine, the development terminals, and one local processor are acquired, the other processors and terminals need not be acquired until the libraries are immediately ready to use them.

Within each subsystem, it is planned to program one task at a time. (Note on the bar chart that Order specification overlaps Order programming. That is because some tasks have been designed and are being programmed while others are being designed.) Thus, the intent of the program is to have results coming at short intervals so that large sums of money will not have to be risked before seeing results.

V.C.3 Hardware Costs in Detail

The total costs for the central facility, local processors and terminals are itemized in Appendices D.4.2, D.6, G.2, and G.4. It should be noted that these costs are for hardware and related expenses only. Program development costs are summarized in Sec. I. They are to be considered as an investment to be amortized over the life of the Order and Standard Loan Subsystems.

The hardware and related costs as they occur in time could follow a plan as outlined here. A detailed version of this plan is contained in Appendix Z.

DATE	PROCUREMENT		
1/72	Central Machine, PDP, Terminals		
10/72	PDP, Staff, Terminals	-	Campus 1
12/72	PDP, Staff, Terminals	-	Campus 2
3/73	PDP, Staff, Terminals	-	Campus 3
5/73	PDP, Staff, Terminals	-	Campus 4
7/73	PDP, Staff, Terminals	-	Campus 5
10/73	PDP, Staff, Terminals	-	Campus 6
	Loan Terminals	-	Campus 1
12/73	PDP, Staff, Terminals	-	Campus 7
	Loan Terminals	-	Campus 2
3/74	PDP, Staff, Terminals	-	Campus 8
	Loan Terminals	-	Campus 3
6/74	PDP, Staff, Terminals	-	Campus 9
	Loan Terminals	-	Campus 4
8/74	Loan Terminals	-	Campus 5
11/74	Loan Terminals	-	Campus 6
1/75	Loan Terminals	-	Campus 7
3/75	Loan Terminals	-	Campus 8
5/75	Loan Terminals	-	Campus 9

Using the hypothetical procurement schedule just outlined, monthly costs were calculated for fiscal years 72 through 75. These costs are summarized in the second column of figures in V.C-2 through V.C-5 and are based on the calculations in Appendix Z. The costs are based on the assumption that ADP's 360/65 could be taken over by the libraries as the central machine. If the 65 were not available, Berkeley's 360/40 should be considered. If purchased, it would reduce total hardware costs about 3%, but would have little expansion capability for other subsystems. If leased, it would add about 3% to the total hardware costs shown in this section. A new machine could be leased for about a 3% increase in total hardware costs also, but getting delivery as soon as January, 1972 might be difficult. The other columns in figures V.C-2 through V.C-5 represent a distribution of the total costs into four functional areas: design, order initiation, order receiving and loan. The distribution is based on the percentages given in Figure V.C-6. These percentage figures are based on the cost ratios derived in the cost study for order initiation, and standard loan. It is recognized that the relative costs of these three functions under the manual operations probably are quite different from the relative costs which will result with the implementation of the new mechanized systems. However, at the present time, this arbitrary method of proportioning the new costs of equipment and related expenses which will be shared by all three functions seems as reasonable as any. The 10% allocated to design is an arbitrary number.

After the fiscal year 1975, hardware costs level off dramatically, the main cause of any increase being attributed to salary increases for computer personnel. In fact, if hardware were purchased, the amortization period would be ending and costs would drop off. Monthly costs were not calculated beyond fiscal '75. Yearly costs were estimated instead. Figure V.C.7 presents yearly data which summarizes the monthly data of figures V.C.2 through V.C.5 and extrapolates costs out to fiscal year '81. The monthly costs for fiscal years '76 through '81 are assumed to be a constant one-twelfth the yearly costs for each fiscal year.

This section is concluded with three graphs which plot expenditures according to three broad categories: development, implementation, and production operations. Note that the conservative assumption has been made that there will be no replaceable costs until implementation at over half of the campuses has been completed. Thus, all of the new operating costs for computers, etc. during the initial implementation phase are treated as additional development expenses. In fact, some replaceable costs may be realized during this period

DATE	TOTAL COST	DESIGN	ORDER INITIATION	ORDER RECEIVING	LOAN
7/71	-	-	-	-	-
8/71	-	-	-	-	-
9/71	-	-	-	-	-
10/71	-	-	-	-	-
11/71	-	-	-	-	-
12/71	-	-	-	-	-
1/72	21,480	21,480	-	-	-
2/72	21,480	21,480	-	-	-
3/72	21,480	21,480	-	-	-
4/72	21,480	21,480	-	-	-
5/72	21,480	21,480	-	-	-
6/72	21,480	21,480	-	-	-
TOTALS:	128,880	128,880	0	0	0

FIGURE V.C-2: Fy 1972 New Hardware and Related Costs by Month

DATE	TOTAL COST	DESIGN	ORDER INITIATION	ORDER RECEIVING	LOAN
7/72	21,625	21,625	-	-	-
8/72	21,625	21,625	-	-	-
9/72	21,625	21,625	-	-	-
10/72	28,640	28,640	-	-	-
11/72	28,640	28,640	-	-	-
12/72	33,400	33,400	-	-	-
1/73	33,400	33,400	-	-	-
2/73	33,400	33,400	-	-	-
3/73	38,140	38,140	-	-	-
4/73	38,140	38,140	-	-	-
5/73	42,880	42,880	-	-	-
6/73	42,880	42,880	-	-	-
TOTALS:	384,395	384,395	0	0	0

FIGURE V.C-3: Fy 1973 New Hardware and Related Costs by Month

DATE	TOTAL COST	DESIGN	ORDER INITIATION	ORDER RECEIVING	LOAN
7/73	49,000	4,900	19,100	25,000	-
8/73	49,000	4,900	19,100	25,000	-
9/73	49,000	4,900	19,100	25,000	-
10/73	60,250	6,000	23,500	30,700	-
11/73	60,250	6,000	23,500	30,700	-
12/73	66,000	6,600	25,700	33,700	-
1/74	66,000	6,600	25,700	33,700	-
2/74	66,000	6,600	25,700	33,700	-
3/74	71,750	7,200	28,000	36,600	-
4/74	71,750	7,200	28,000	36,600	-
5/74	71,750	7,200	28,000	36,600	-
6/74	75,600	7,200	29,500	38,600	-
TOTALS:	756,350	75,700	294,900	385,900	0

FIGURE V.C-4: Fy 74 New Hardware and Related Costs by Month

DATE	TOTAL COST	DESIGN	ORDER INITIATION	ORDER RECEIVING	LOAN
7/74	77,450	-	15,500	20,150	41,800
8/74	78,400	-	15,700	20,400	42,350
9/74	78,400	-	15,700	20,400	42,350
10/74	78,400	-	15,700	20,400	42,350
11/74	79,300	-	15,850	20,600	42,800
12/74	79,300	-	15,850	20,600	42,800
1/75	80,300	-	16,050	20,900	43,350
2/75	80,300	-	16,050	20,900	43,350
3/75	81,300	-	16,250	21,150	43,900
4/75	81,300	-	16,250	21,150	43,900
5/75	82,200	-	16,450	21,400	44,400
6/75	82,200	-	16,450	21,400	44,400
TOTALS:	958,850	0	191,800	249,450	517,750

FIGURE V.C-5: Fy 75 New Hardware and Related Costs by Month

Date		Design	Ord. Init	Ord. Rec.	Std. Loan
7/71	Planning and Analysis (Hardware and Order)	0%	0%	0%	0%
1/72	Order Requirements - Hardware Implementation	100%	0%	0%	0%
2/72	Hardware Systems Test and Order Design	100%	0%	0%	0%
10/72	Order Design and Early Order Implementation	100%	0%	0%	0%
7/73	Order Implementation and Loan Design and Early Loan Implementation	10%	39%	51%	0%
7/74	Order Implementation and Operation and Loan Implementation and Operation	0%	20%	26%	54%
7/75	Order and Loan Operation (Total UC)(Steady State)	0%	20%	26%	54%

Figure V.C-6 Distribution of New Hardware and Related Costs

Year	Total Cost	Design	Order Initiation	Order Receiving	Std. Loan
70/71	-	-	-	-	-
71/72	128,900	128,900	-	-	-
72/73	384,400	384,395	-	-	-
73/74	756,400	75,700	294,900	385,900	-
74/75	958,900		191,800	249,400	517,700
75/76	1,000,000	-	200,100	260,200	540,300
76/77	1,017,400	-	203,500	264,500	549,400
77/78	1,035,000	-	207,000	269,100	558,900
78/79	957,500	-	191,500	249,000	517,000
79/80	635,600	-	141,600	184,100	382,400
80/81	639,800	-	140,700	182,900	380,000

Figure V.C-7 Hardware Costs by Year
(Derivation of Values explained in Appendix Z)

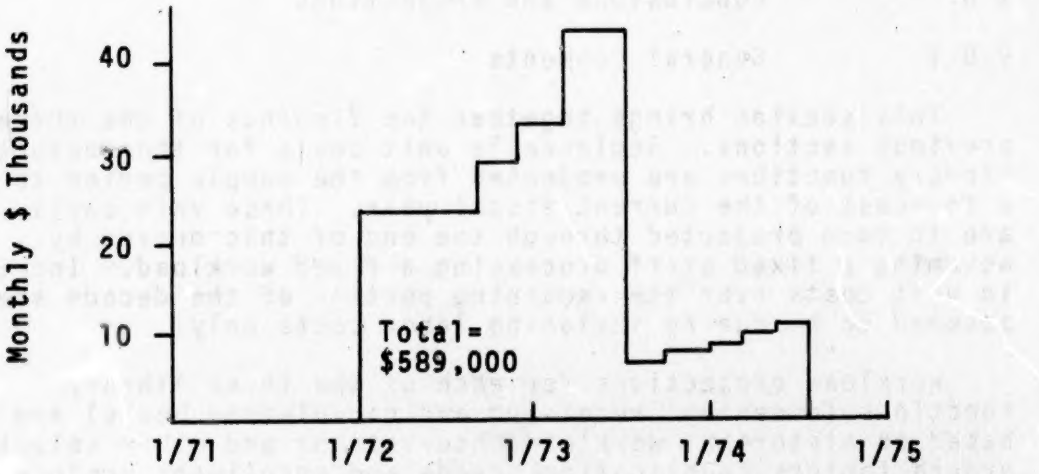


Figure V.C-8 Hardware Costs Allocated to Development

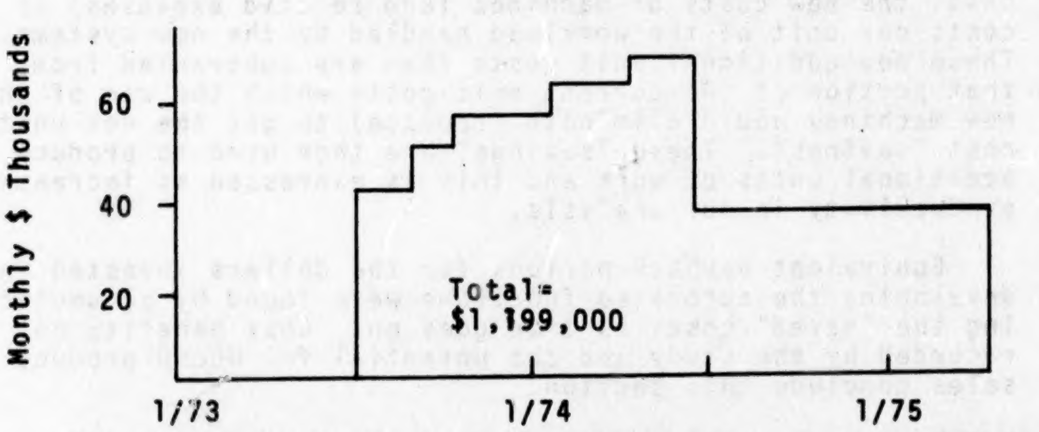


Figure V.C-9 Hardware Costs Allocated to Implementation

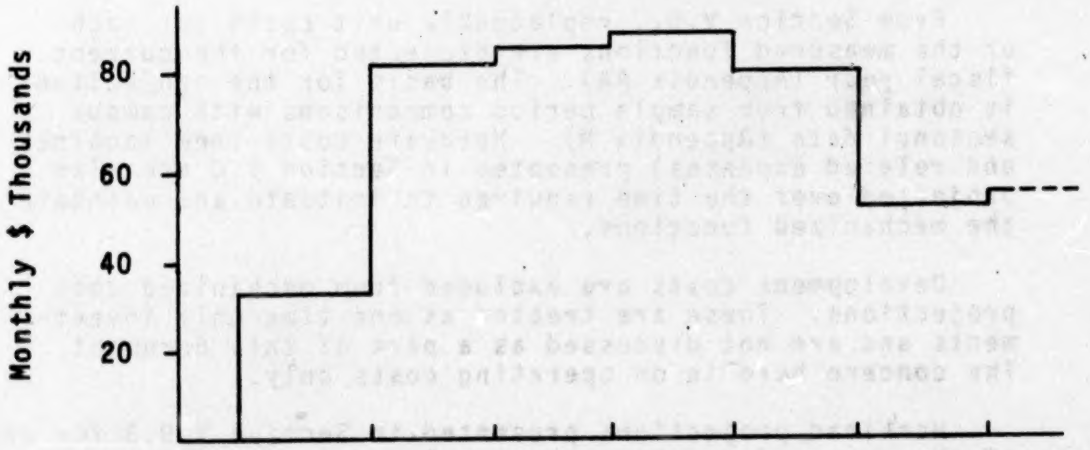


Figure V.C-10 Hardware Costs Allocated to Operation

V.D. Conclusions and Projections

V.D.1 General Comments

This section brings together the findings of the three previous sections. Replaceable unit costs for the measured library functions are projected from the sample period to a forecast of the current fiscal year. These unit costs are in turn projected through the end of this decade by assuming a fixed staff processing a fixed workload. Increases in unit costs over the remaining portion of the decade are assumed to be due to inflating labor costs only.

Workload projections for each of the three library functions (ordering, receiving and circulating books) are based on historical workload observations and other selected growth factors (publication trends and enrollment projections). The projected workloads then are employed to express the new costs of machines (and related expenses) as costs per unit of the workload handled by the new systems. These new additional unit costs then are subtracted from that portion of the current unit costs which the use of the new machines would eliminate (replace) to get the net unit cost "savings". These "savings" are then used to produce additional units of work and this is expressed as increased productivity in our analysis.

Equivalent payback periods for the dollars invested in developing the automated functions were found by accumulating the "saved" costs as time goes on. Cost benefits not recorded by the study and the potential for UCLSD product sales conclude this section.

V.D.2 Replaceable Manual Versus Mechanized Unit Cost Comparisons

From Section V.B., replaceable unit costs for each of the measured functions are projected for the current fiscal year (Appendix AA). The basis for the projection is obtained from sample period comparisons with campus seasonal data (Appendix M). Hardware costs (new machines and related expenses) presented in Section V.C are also projected over the time required to initiate and maintain the mechanized functions.

Development costs are excluded from mechanized cost projections. These are treated as one time only investments and are not discussed as a part of this document. The concern here is on operating costs only.

Workload projections presented in Section V.D.3 for each of the measured functions are employed to determine mechanized unit costs. Assuming a fixed budget for each function, it is proposed that the mechanized system is able to process the increased workloads while the manual functions are able to process only current work loads. Replaceable-manual unit costs are seen to grow due to a 5.2% cost-of-living salary increase compounded annually commencing with Fiscal Year 1972. The justification for this cost increase is explained in Appendix AA.

Figure V.D-1a shows the unit replaceable costs along with the new added unit costs for the Order Initiation function. The new added unit costs for machines and related expenses calculated in Section V.C. have been divided by the projected workload (discussed in Section V.D.3) to obtain the estimated new costs per unit of workload. As can be seen in the figure, the unit costs are very high (about twice as high) during the implementation phase when the new mechanized procedures are handling only a portion of the total workload. Then, when all campuses are using the system, the costs drop to a level that remains almost constant due to the compensating effects of inflationary increases in operating staff salaries (about one third of the total new costs) and increasing workload handled by the initially installed equipment. The declining costs after seven or eight years is due to equipment becoming fully amortized. We recognize that some of the equipment will "wear out" and need to be replaced and eventually additional equipment will need to be acquired to handle the increasing workload. So, the conservative assumption has been made that new unit costs will remain at a constant level starting on the date the new systems are fully implemented. The value selected is the maximum unit cost of 47¢ that occurrs in 1977/78. Thus, again, a conservative assumption has been made.

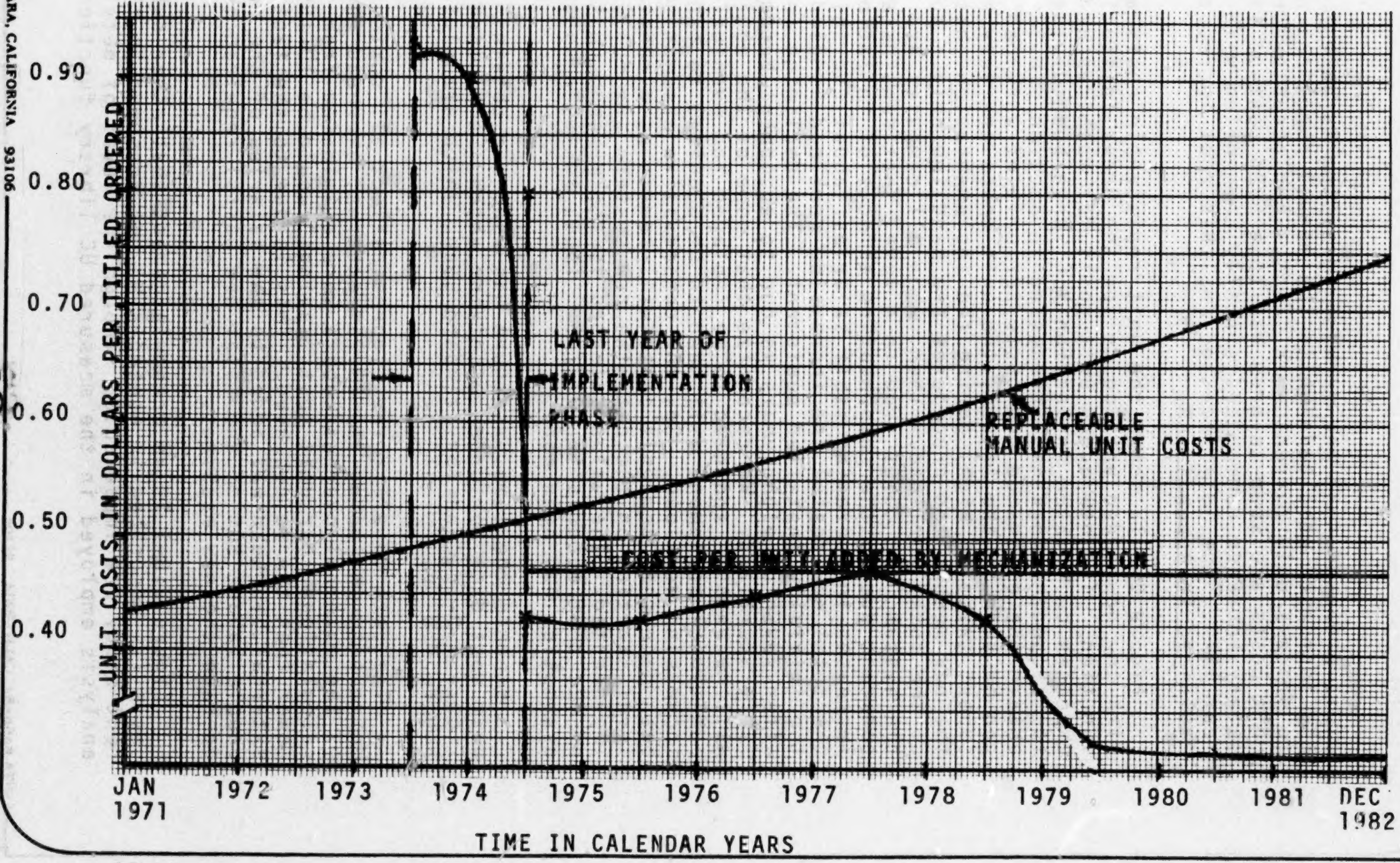
Exactly the same procedure was used for obtaining the unit cost data for Order Receiving which are plotted in Figure V.D-1b, and for Standard Loan, which are plotted in Figure V.D-1c.

The data in all three figures reflect all costs to the University including the 23.75% external overhead costs. If the external overhead costs were eliminated from the calculations, our unit cost "savings" would be 10-15% lower than the values used. This is due to the fact that external overhead was added to the salaries of the new people (about 30% of the total new costs) required to operate the new machines.

Figure V.B-1 is an acknowledgement that other subsystem costs (as described in Appendix M) not measured in the current study are impactable. Though the level of detail in analysis employed in the measured UC library functions was

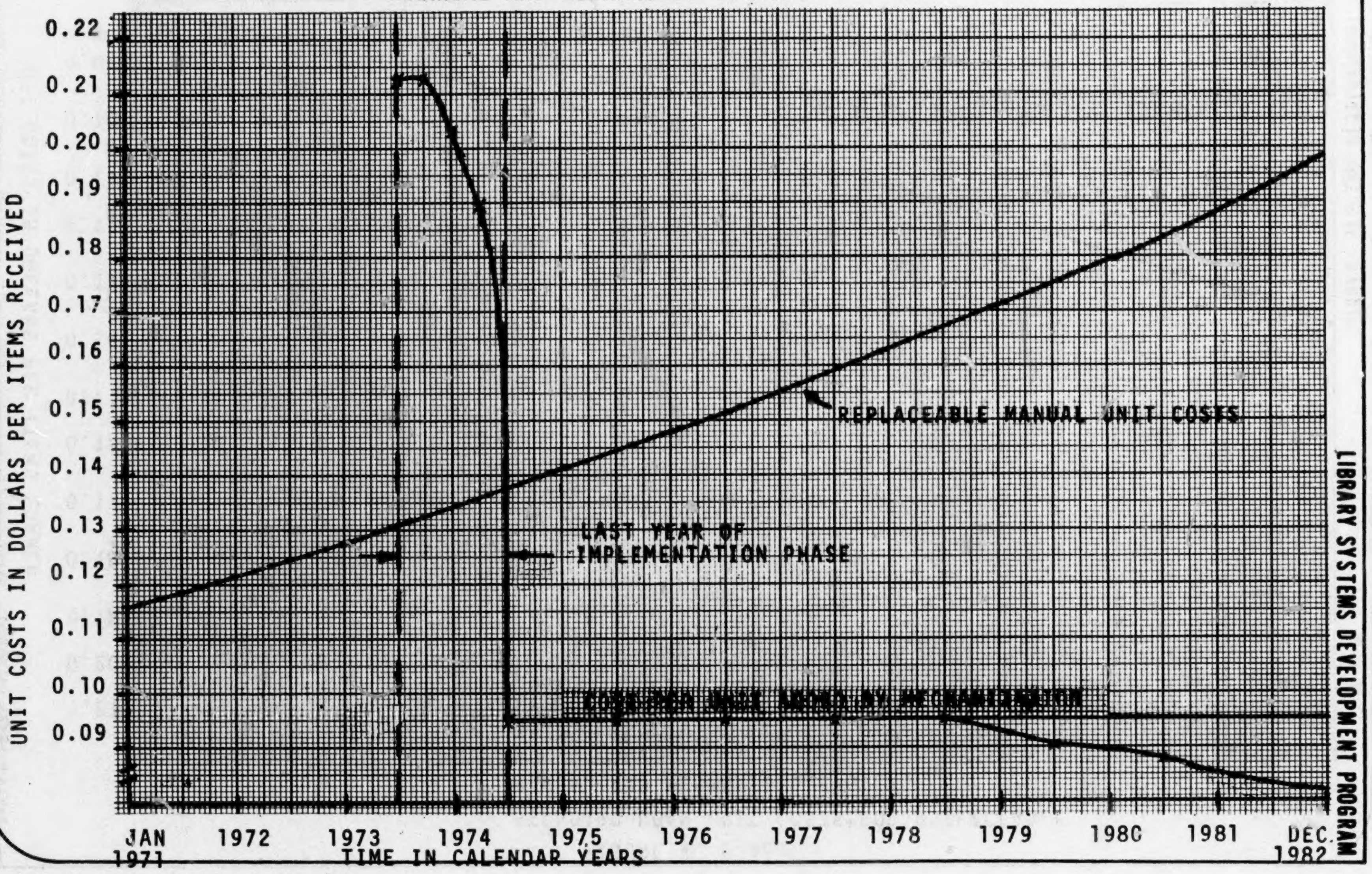
FIGURE V.D-1a

ORDER INITIATION UNIT COSTS*FOR REPLACEABLE MANUAL AND MECHANIZED SYSTEMS



*Includes external burden

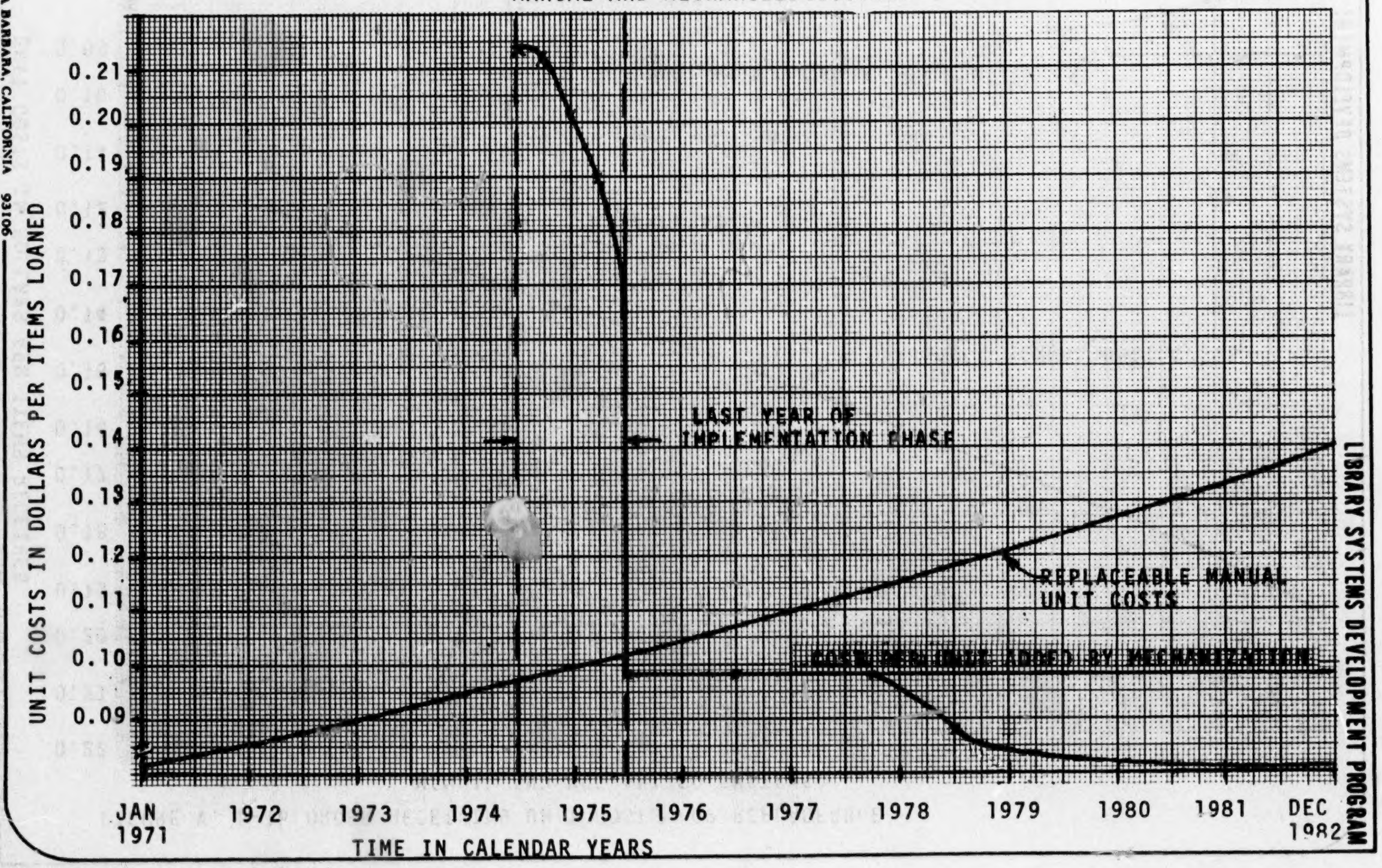
FIGURE V. D-1b ORDER RECEIVING UNIT COSTS* FOR REPLACEABLE MANUAL AND MECHANIZED SYSTEMS



*Includes external burden.

FIGURE V. D-1c

STANDARD LOAN UNIT COSTS*FOR REPLACEABLE MANUAL AND MECHANIZED SYSTEMS



*Includes external burden

not applied to the other subsystems, gross measures of replaceability were made for select modules and functions in LSD 70-41. They are repeated here though no attempt was made to select parameters for workload projections for the selected functions. However, the methodology developed for evaluating Order and Standard Loan probably could be applied to the other areas to develop estimates of unit cost "savings".

V.D.3 Growth of Workloads

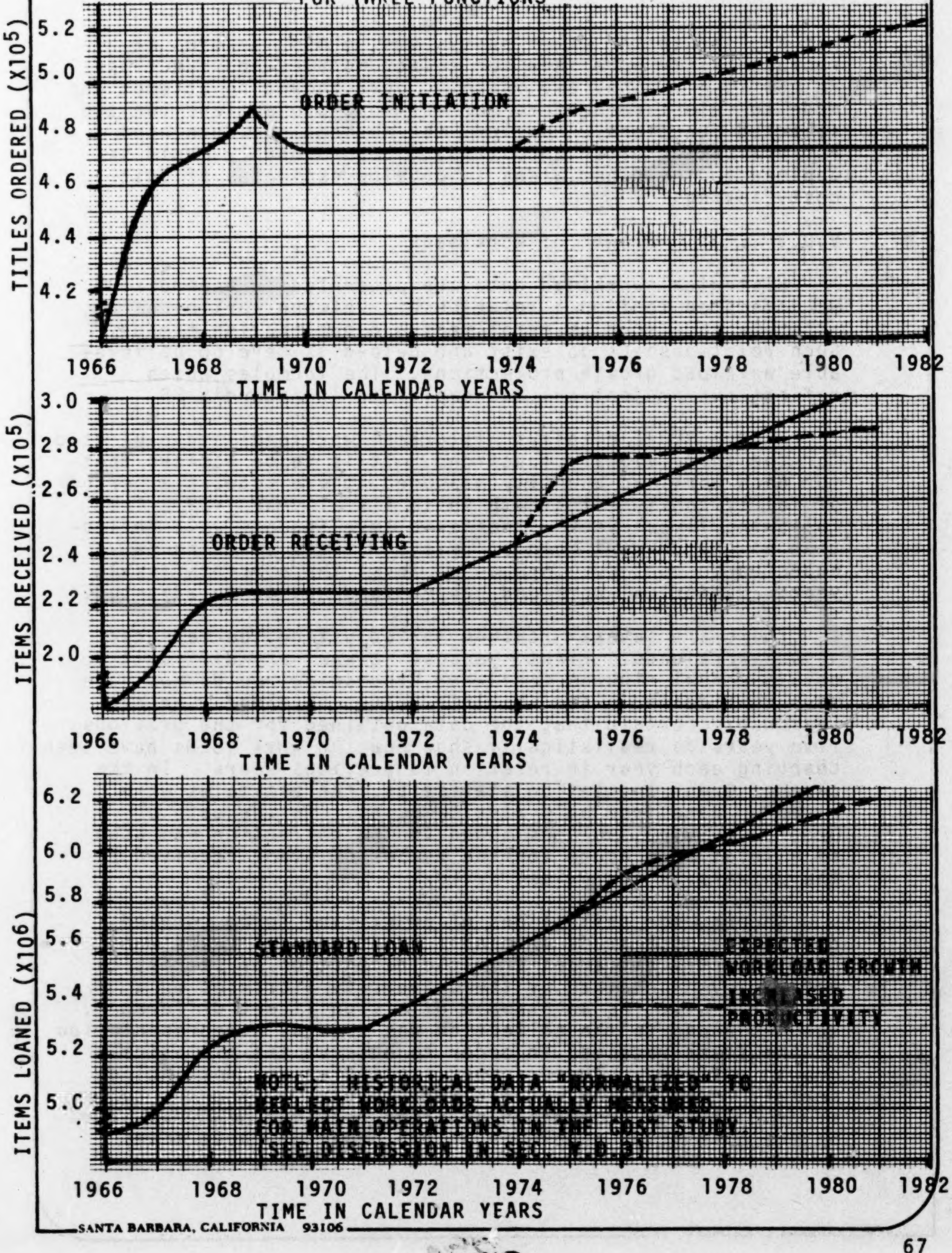
Historical workload data are presented in Appendix BB. We attempted to find a relationship between workload and other factors such as enrollment and publication trends. Such relationships do exist and helped us develop believeable workload growth projections. The formulas which reflect our projections are explained in Appendix BB.

Figure V.D-2 displays historical workloads and projected for the three library functions. It is to be noticed that for each workload quantity measured, there appears a period of fairly consistent growth up to fiscal year 1969. The following fiscal year witnesses a leveling off as a reflection of the current "budget crisis". This leveling is expected to continue through at least the current fiscal year. Historical workload projections had to be adjusted.

There are several reasons for adjusting the measured annual workloads. First, because it was very difficult to obtain annual figures for Order Processing, we do not have much confidence in the absolute values obtained. We are reasonably certain that the data obtained for the previous five years do realistically show how the work loads have been changing each year in relation to previous years. In the case of Order Initiation statistics, the estimates were based on data from only five campuses. In the case of Order Receiving, volumes added to the collection was used as a relative measure for the number of items received by the University libraries.

Second, the definitions of quantities to be counted during the cost study (Appendix N) in several cases were significantly different from the definition of statistics ordinarily maintained by the University libraries on a regular basis. As an example of a significant difference, volumes added to the collection was used as a representation of the items received in order to observe the historical growth patterns. These annual statistics did not include serials received and serials were counted during the cost study. Thus, a projection of items received per year based on the cost study sample is on the order of three times

FIGURE V.D-2
INDUCED INCREASES IN WORK LOAD CAPACITY DUE TO AUTOMATION FOR THREE FUNCTIONS



NOTE: HISTORICAL DATA "NORMALIZED" TO REFLECT WORK LOADS ACTUALLY MEASURED FOR MAIN OPERATIONS IN THE COST STUDY. (SEE DISCUSSION IN SEC. V.D.3) the size of the annual statistic we were able to obtain from the campuses.

Third, in computing unit replaceable costs, we have excluded the work classified as SECONDARY by the campus libraries. This was done for reasons discussed in Section V.B.3. Although our calculations show that only 13% of all replaceable costs would result from the mechanization of SECONDARY operations (if it is possible at all), these operations handle a significant portion of the workloads currently (about 12% for Order Initiation, 20% for Order Receiving, and 30% for Circulation). In discussing the case for mechanization, both the replaceable costs and the workload for the SECONDARY operations have been excluded from the analyses. Some of the organizational units, thus excluded, were reporting statistics that were included in the annual workload data which we obtained from the campuses. Again, an annual projection of workload based on the levels observed during the cost study period with these exclusions would not be comparable to the available annual statistics.

In order to make the measured replaceable unit costs and the projected annual workload volumes comparable, it was necessary to base annual projections on the adjusted volumes actually measured during the cost study. The workloads actually observed for the three functional areas had to be further adjusted to account for known seasonal variations in workload as discussed in Section V.A.2. The number of items circulated during the sample period appear to be about 20% higher than the annual average. The measurement of items circulated during the sample period was reduced by 20% (actually from 120% to 100%) and this was assumed to be typical of the annual average circulation rate. The number of items ordered and received during the sample period appears to be characteristic of the annual average and no adjustment was made. After all of these necessary adjustments were made, the projected annual (1970/71) workload for each of the three areas is: 473,000 titles ordered, 2.25 million items (all types of material) received, and 5.31 million items circulated.

The projection of expected workload growth is shown as a solid line in Figure V.D-2. The projected order initiation workload remains constant due to the nullifying effects of assumed increased usage of standing order and approval plans for book ordering. Varying acquisition policies on the campuses made anything other than constant projection tenuous.

Order Receiving workload projections are based partially on the relationship we found (p.5, Reference 45) between titles published in the U.S. and volumes added to the UC libraries. Library acquisition rates tend to follow the general economic trends of the country as a whole so that we are projecting a long term linear growth rate of 4% per year (of the 71/72 level) (considerably lower than the current rate of inflation). We do assume that the current budget restrictions will curtail any growth until the end of 1971/72 at which time we assume growth will continue.

Circulation workloads historically have depended on enrollment levels as shown in Appendix BB. The well-established trend was interrupted in 1969/70 for reasons which are not entirely clear. Nevertheless, we assume that "normal" times will return and that enrollments will increase (linearly) approximately 5% (of the 71/72 level) per year during the next decade. Using this assumption and the relationship we found between enrollment and circulation,we project a linear circulation workload increase of 2% per year (circulation was increasing 0.4% for each 1% enrollment increase) and this is lower than the 3-4% increase observed in recent years. Again, our assumptions are conservative.

V.D.4 Impact on Productivity

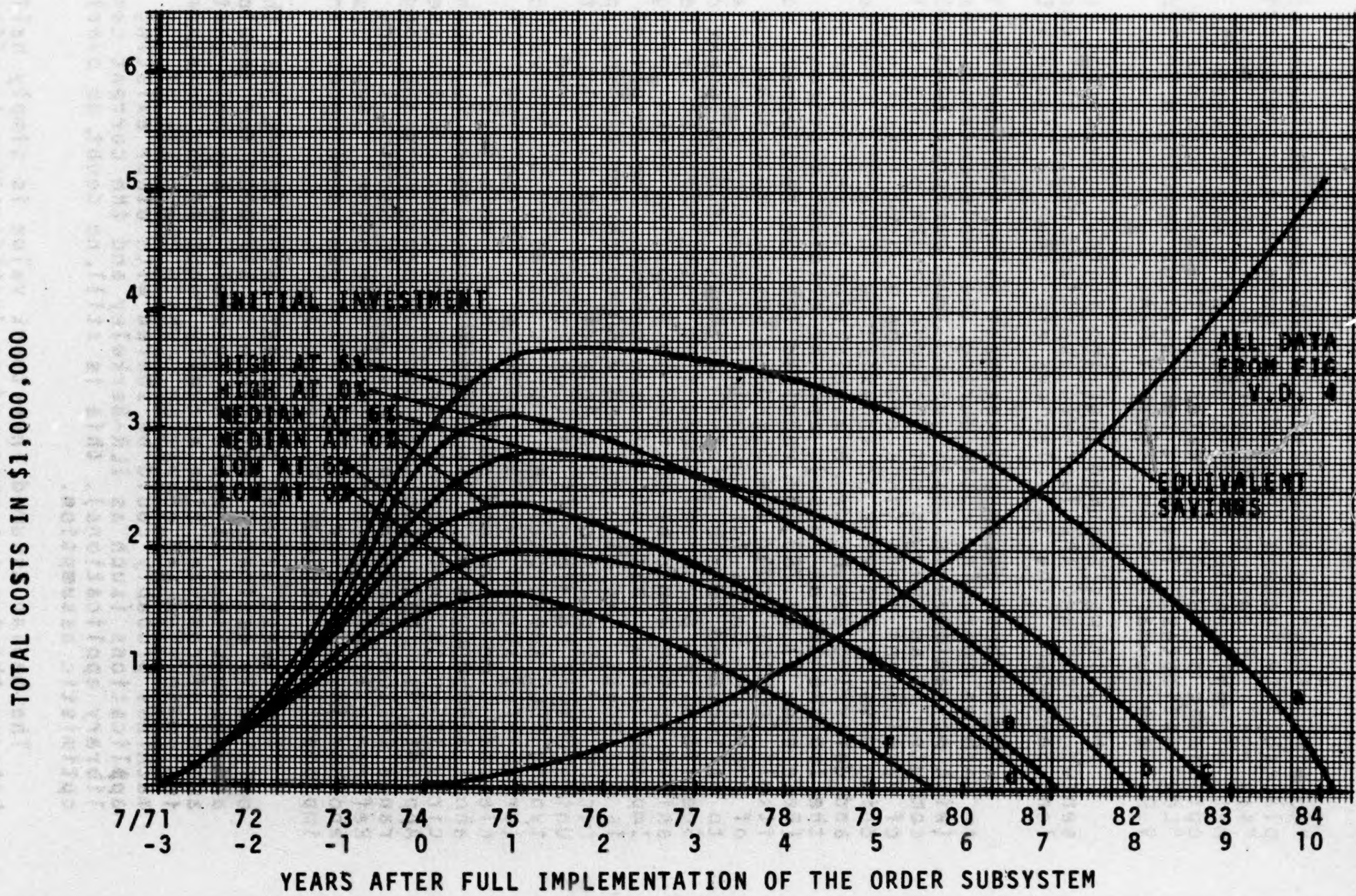
To project the possible impact that automation may have on productivity, the following assumptions were made: (1) a library staffing level fixed at its value on the date implementation is complete in the library functions impacted by the mechanized systems, (2) constant productivity of labor with increasing workloads for the manual systems, and (3) workloads growing at the rates assumed in Section V.D.3. These assumptions allow a comparison to be made between the static productivity of manual systems and the increasing productivity of mechanized systems.

Figure V.D-2 shows how the new system can handle significant portions of the increased workload that is projected without any increase in operating budget for the three functions. Of course, additional funds are required for that portion of the workload increase which the existing staff aided by their machines cannot handle. This analysis is somewhat artificial because no increase in Order Initiation workload is assumed and the mechanized system would have the capacity to absorb some increase as shown in the figure. The derivation of the productivity projections is found in Appendix CC.

V.D.5. Equivalent Payback Periods

Equivalent payback periods were calculated for various assumptions of initial investment required. The results are shown graphically in Figure V.D-3. The "Equivalent Savings" were obtained by multiplying the expected annual workload by the unit cost "savings" and accumulating the

FIGURE V. D - 3
EQUIVALENT SAVINGS AND AMORTIZED
LOAN VALUE VS. TIME



"total savings" as time passes. The "best" estimates of Replaceability Factors (Appendix X) were used in calculating "savings". Please note (Figure V.B.-1) that the "best" estimate of replaceable costs is about half way between the most optimistic or "High" estimates and the most pessimistic or "Low" estimates. The unit cost savings developed in Section V.D.1 are summarized in Figure V.D-4.

Then, it was assumed that the initial investment represented a loan and the loan was amortized out of the "Equivalent Savings". The calculations are shown in Figure V.D-5.

The highest assumed investment value includes: $1,199,000 in machine operating costs during the Implementation Phase (with no replaceable costs during that period); $289,000 in computer lease charges not included in the original estimates of development costs (this could be avoided possibly by doing development work on an existing University computer and deferring new hardware acquisition to the beginning of the Implementation Phase); and the originally estimated (Reference 1) $1,780,000 required for the development work itself (covers Order and Standard Loan). Note that the cost of preparing books for mechanized circulation has been assumed to be included in the original estimate of development costs. Specifically, personnel freed from tasks replaced by the mechanized system would be shifted to preparing books during the Implementation Phase of the development. The amount of effort is not great. We have assumed a 50 character bibliographic record for circulation (See Appendix E) and if half of the University's holdings (6 million books) are prepared by clerks typing 6000 keystrokes per hour, a total of 50,000 manhours (or 25 FTE) spread over two years will be required. If the clerical time is valued at $4 per hour, this task would cost about $200,000 total. Preparation of new books for mechanized circulation is an integral part of the order process (see Appendix U). Note also that program management and long range systems planning cost discussed in Section I (and Reference 1) have been omitted at this point. These costs add another $441,000 over the first five year development and implementation period. (Reference 1).

The lowest assumed investment value covers just the originally estimated (Reference 1) $1780000 for development and assumes that it would be possible to buy only that amount of computer time actually required for development, implementation and operation. While the costs of the new machines probably could be shared with other existing applications (such as ILR-Berkeley and the current campus library applications), this is still, no doubt, an overly optimistic assumption.

The median assumed investment value is simply halfway between the two extremes and no justification is offered for its inclusion.

FIGURE VD-4a

PROJECTED ANNUAL "SAVINGS"
FOR
ORDER INITIATION

YEAR	ORDER INITIATION				
	Orders Placed x 10^5	Repl. Unit Cost* $	Added Unit Cost* $	Unit Cost* Saving $	Annual Total Cost* "Saving" $ x 10^3
70/71	4.73	0.437	-----	-----	-----
71/72	4.73	0.459	-----	-----	-----
72/73	4.73	0.482	-----	-----	-----
73/74	4.73	0.506	-----	-----	-----
74/75	4.73	0.531	0.470	0.061	28.8
75/76	4.73	0.557	0.470	0.087	41.2
76/77	4.73	0.585	0.470	0.115	54.4
77/78	4.73	0.614	0.470	0.144	68.1
78/79	4.73	0.645	0.470	0.175	82.8
79/80	4.73	0.677	0.470	0.207	97.9
80/81	4.73	0.711	0.470	0.241	114.0
81/82	4.73	0.747	0.470	0.277	131.0
82/83	4.73	0.784	0.470	0.314	148.5
83/84	4.73	0.823	0.470	0.353	166.9
84/85	4.73	0.864	0.470	0.394	186.2
85/86	4.73	0.907	0.470	0.437	206.7

*Includes external burden and assumes "Best" replaceability factors from Appendix X.

FIGURE VD-4b

PROJECTED ANNUAL "SAVINGS"
FOR
ORDER RECEIVING

YEAR	ORDER RECEIVING				
	Items Rec'd x10^6	Repl. Unit Cost* $	Added Unit Cost* $	Unit Cost* "Saving" $	Annual Total Cost* "Savings" $ x 10^3
70/71	2.25	0.116	-----	-----	-----
71/72	2.25	0.122	-----	-----	-----
72/73	2.34	0.128	-----	-----	-----
73/74	2.43	0.134	-----	-----	-----
74/75	2.52	0.141	0.095	0.046	115.9
75/76	2.61	0.148	0.095	0.053	138.3
76/77	2.70	0.155	0.095	0.060	161.8
77/78	2.79	0.163	0.095	0.068	189.6
78/79	2.88	0.171	0.095	0.076	218.9
79/80	2.97	0.179	0.095	0.084	249.6
80/81	3.06	0.188	0.095	0.093	284.3
81/82	3.15	0.198	0.095	0.103	324.5
82/83	3.24	0.208	0.095	0.113	366.1
83/84	3.33	0.218	0.095	0.123	409.6
84/85	3.42	0.229	0.095	0.134	458.4
85/86	3.51	0.240	0.095	0.145	509.0

*Includes external burden and assumes "Best" replaceability factors from Appendix X.

FIGURE VD-4c

PROJECTED ANNUAL "SAVINGS" FOR STANDARD LOAN

YEAR	STANDARD LOAN				
	Items Loaned x 10^6	Repl. Unit Costs* $	Added Unit Cost* $	Unit Cost* "Savings" $	Annual Total Cost* "Savings" $10^3$$
70/71	5.31	0.082	-----	-----	-----
71/72	5.42	0.086	-----	-----	-----
72/73	5.52	0.090	-----	-----	-----
73/74	5.63	0.095	-----	-----	-----
74/75	5.74	0.100	-----	-----	-----
75/76	5.84	0.104	0.098	0.006	35.0
76/77	5.95	0.110	0.098	0.012	71.4
77/78	6.05	0.115	0.098	0.017	102.8
78/79	6.16	0.121	0.098	0.023	141.7
79/80	6.27	0.127	0.098	0.029	181.7
80/81	6.37	0.133	0.098	0.035	223.0
81/82	6.48	0.140	0.098	0.042	272.1
82/83	6.58	0.147	0.098	0.049	322.3
83/84	6.69	0.154	0.098	0.056	374.3
84/85	6.79	0.162	0.098	0.064	434.4
85/86	6.90	0.170	0.098	0.072	496.8

*Includes external burden and assumes "Best" replaceability factors from Appendix X.

FIGURE VD-4d

PROJECTED ANNUAL "SAVINGS"
FOR
STANDARD LOAN AND ORDER SUBSYSTEMS

YEAR	Total Annual Cost* "Saving" 10^3\$	Cumulated Cost* "Savings" 10^3\$
70/71	------	-------
71/72	------	-------
72/73	------	-------
73/74	------	-------
74/75	144.7	144.7
75/76	214.5	359.7
76/77	287.6	646.8
77/78	360.5	1007.3
78/79	443.4	1450.7
79/80	529.2	1979.9
80/81	621.3	2601.2
81/82	727.6	3328.8
82/83	836.9	4165.7
83/84	950.8	5116.5
84/85	1078.9	6195.4
85/86	1212.5	7407.9

*Includes external burden and assumes "Best" replaceability factors from Appendix X.

FIGURE VD-5a

PAYBACK CALCULATIONS
(High Investment Assumed)

6%	Annual Interest Rate Assumed
$3274000	Initial Investment Assumed

Year (A)	Value of "Loan" (B) $1000	Annual "Interest" on "Loan" (C) $1000	Total* Annual "Savings" (D) $1000	New Value of "Loan" B+C-D $1000
70/71	0	---	----	0
72	500	30	----	530
73	1530	92	----	1622
74	2896	174	----	3070
75	3570	214	145	3639
76	3639	218	214	3643
77	3643	219	288	3574
78	3574	214	360	3428
79	3428	206	443	3191
80	3191	191	529	2853
81	2853	171	621	2403
82	2403	144	728	1819
83	1819	109	837	1091
84	1091	65	951	205
85	205	12	1079	-862

*From Figure V.D-4d.

FIGURE VD-5b

PAYBACK CALCULATIONS
(High Investment Assumed)

0% Annual Interest Rate Assumed
$3274000 Initial Investment Assumed

Year (A)	Value of "Loan" (B) $1000	Annual "Interest" on "Loan" (C) $1000	Total* Annual "Savings" (D) $1000	New Value of "Loan" B+C-D $1000
70/71	0	---	---	0
72	500	0	---	500
73	1500	0	---	1500
74	2774	0	---	2774
75	3274	0	145	3129
76	3129	0	214	2915
77	2915	0	288	2627
78	2627	0	360	2267
79	2267	0	443	1824
80	1824	0	529	1295
81	1295	0	621	674
82	674	0	728	-54
83	----	---	---	----
84	----	---	---	----
85	----	---	---	----

*From Figure V.D-4d.

FIGURE VD-5c

PAYBACK CALCULATIONS
(Median Investment Assumed)

6%	Annual Interest Rate Assumed
$2530000	Initial Investment Assumed

Year (A)	Value of "Loan" (B) $1000	Annual "Interest" on "Loan" (C) $1000	Total* Annual "Savings" (D) $1000	New Value of "Loan" B+C-D $1000
70/71	0	---	---	0
72	500	30	---	530
73	1330	80	---	1410
74	2210	133	---	2343
75	2773	166	145	2794
76	2794	168	214	2748
77	2748	165	288	2625
78	2625	158	360	2422
79	2422	145	443	2125
80	2125	127	529	1723
81	1723	103	621	1206
82	1206	72	728	550
83	550	33	837	-254
84	---	---	---	----
85	----	---	---	----

*From Figure V.D-4d.

FIGURE VD-5d

PAYBACK CALCULATIONS
(Median Investment Assumed)

0% Annual Interest Rate Assumed
$2530000 Initial Investment Assumed

Year (A)	Value of "Loan" (B) $1000	Annual "Interest" on "Loan" (C) $1000	Total* Annual "Savings" (D) $1000	New Value of "Loan" B+C-D $1000
70/71	0	0	---	0
72	500	0	---	500
73	1300	0	---	1300
74	2100	0	---	2100
75	2530	0	145	2385
76	2385	0	214	2171
77	2171	0	288	1883
78	1883	0	360	1523
79	1523	0	443	1080
80	1080	0	529	551
81	551	0	621	-70
82	----	-	---	----
83	----	-	---	----
84	----	-	---	----
85	----	-	---	----

*From Figure V.D.-4d.

FIGURE VD-5e

PAYBACK CALCULATIONS
(Low Investment Assumed)

6%	Annual Interest Rate Assumed
$1786000	Initial Investment Assumed

Year (A)	Value of "Loan" (B) $1000	Annual "Interest" on "Loan" (C) $1000	Total* Annual "Savings" (D) $1000	New Value of "Loan" B+C-D $1000
70/71	0	---	---	0
72	500	30	---	530
73	1030	62	---	1092
74	1592	95	---	1687
75	1967	118	145	1940
76	1940	116	214	1842
77	1842	111	288	1665
78	1665	100	360	1405
79	1405	84	443	1046
80	1046	63	529	580
81	580	35	621	6
82	6	---	728	-722
83	---	---	---	----
84	---	---	---	----
85	---	---	---	----

*From Figure V.D-4d.

FIGURE VD-5f

PAYBACK CALCULATIONS
(Low Investment Assumed)

0%	Annual Interest Rate Assumed
$1786000	Initial Investment Assumed

Year (A)	Value of "Loan" (B) $1000	Annual "Interest" on "Loan" (C) $1000	Total* Annual "Savings" (D) $1000	New Value of "Loan" B+C-D $1000
70/71	0	0	---	0
72	500	0	---	500
73	1000	0	---	1000
74	1500	0	---	1500
75	1780	0	145	1635
76	1635	0	214	1421
77	1421	0	288	1133
78	1133	0	360	773
79	773	0	443	330
80	330	0	529	-199
81	---	-	---	----
82	---	-	---	----
83	---	-	---	----
84	---	-	---	----
85	---	-	---	----

*From Figure V.D-4d.

The assumed "interest" rates are arbitrary and are included to keep our estimates conservative. Also, the investment build-up is an approximation only. We are prepared to discuss as a separate issue the budget phasing required by the various program options which are available. We have prepared a refined model of the investment amortization process which will permit the reader to assess the impact of changes to any of our assumptions (See Appendix DD).

From the foregoing, it should be apparent that it is difficult to make a concise statement that the new systems will pay for themselves in precisely X years. What we can say is that sometime between five and ten years after the new systems have been installed, the initial investment will be more than offset by operating cost savings resulting from increased library productivity. (I personally believe we have used overly conservative assumptions at every stage of this analysis so that our results are about as pessimistic as they can be made. FLB).

V.D.6 Other Tangible Benefits

Mechanization will produce many additional cost benefits that have not been included in the present study. For the Order Subsystem, mechanization will reduce the likelihood and frequency of unintentional duplication. Mechanization will provide vastly improved support data for development and implementation of collection policies. It will partially reduce the labor investment in book and serial fund accounting and will affect many economies in developing a mechanized interface with University accounting offices. Indeed, one can forsee development of a very different set of procedures, both for accounting and payment, that will affect cost savings both in the libraries and in the University accounting offices.

For Standard Loan, labor savings will be realized through mechanization of the transfer of records to and from reserve collections and enhanced control over the volume, character and policies affecting expenditures on long term loan of materials.

Cost benefits are likely to be realized in the development of improved management information that will affect decisions respecting allocation of physical and human resources. Automated collection of statistical information will provide means of data reduction, data organization and analysis as required for planning, budgeting, supervision and reporting. Timekeeping and scheduling can be mechanized, which will lead to more effective and economic assignment of high level skills. Monitoring available funds at levels consistent with planned rates of expenditure will demonstrate much improvement over the current typical practice of spending until funds run out. Projected support required to meet different workloads at various times of the year is a further value of resource monitoring by computer. These developments would also make it possible for the first time to develop University-wide standards and functional resource statistics that will aid the budgeting process and improve communications with University administration.

From mechanization will result a number of bibliographic publications needed by the UC Libraries, as well as other libraries in the country. The sale of such publications will provide some income to the University. No detailed assessment has been made, but gross income might approach forty thousand dollars per year (excluding the sale of the Union Catalog Supplement).

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VII. Glossary

Automation: the use of machinery for automatically making some of the decisions formerly made by human beings in addition to performing many tasks formerly performed by humans.

Badge Reader: any of a family of devices that read or convert the information contained in a customer identification badge or card to machine readable form.

Batch Operations: computer operations where a large batch of data is accumulated and submitted for computer processing at a later time.

Burden: indirect cost carried by a direct unit of labor. See also External and Internal Overhead.

CBA: Cost Benefit Analysis.

Communications: the dispatch of information in an electronic form from one location to another; including the use of telephone lines.

Configuration: a group of machines that are interconnected and programmed to operate as a system.

Cost Accounting: a procedure for recording the constituent costs of a porcess or job along with the units of production so that costs per unit may be calculated.

Cost Benefits: benefits and savings realizable through mechanization and its associated systems and procedures measured in dollars.

CRT Terminal: a device with a television-like display and (usually) a typewriter-like keyboard for data entry.

Data Base: a body of information available in machine readable form.

Degradation: a special condition when a system continues to operate, but at a reduced level of service.

EFF: Effectiveness Benefits study.

Effectiveness: a qualitative measure of system performance. It is a measure of how well a system satisfies the performance requirements and organizational goals for which it was designed.

FTE: Full Time Equivalent (=Man year).

HAS: Hardware Alternative Study.

Hardware: any machinery, including computers, which can be used by libraries to increase productivity or to improve service.

Impactability: the extent to which a particular task will be affected by mechanized procedures. That is, the proportion of direct work which, in some direct fashion, will be influenced or changed by the implementation of mechanized procedures. Resource savings or change in utilization by Electronic Data Processing.

Input: an input is an event or physical item that triggers an activity response that results in a measureable output. Inputs may be time and/or event related. Can also refer (in the static sense) to any resource committed to an endeavor at any given time.

Input/Output Device: any device used for converting data from machine readable form to human readable form, or conversely. Included are keypunches, key-to-tape devices, CRT terminals, line printers, TWX machines, etc.

Intangible Benefits: benefits which cannot be measured in terms of budget dollars. Intangible benefits would include new or improved services to users, reduced cost to users, or reduced costs and increased benefits to higher education as a whole.

Local Mode: in time-shared and remote-batch systems, the local or self-contained use of a terminal or mini-computer when not interacting with the larger system of which it is a part.

Logic: the basic principles and application of truth tables, the relationship of proportions, the interconnection of on-off circuit elements, for mathematical computation in a computer.

MARC: Machine Readable Cataloging.

Marginal Benefits/Cost: the incremental gain or loss to a consumer (investor) by an incremental addition of an input is called marginal benefits/cost.

Mark Sense Reader: a device which produces a machine record of data which has been placed on a card or piece of paper in the form of heavy black lines.

Mechanized: the use of machines to perform some portion of the routine tasks formerly performed by human labor.

Modem: a device for transforming the electronic signals produced by an input/output device into a form which can be put on a telephone line for transmission to another location.

Module: a functional subdivision of a subsystem. It is a portion of a subsystem devoted to a single process. A module is a set of functions that are required to achieve a relatively small set of related objectives. These functions may include and utilize people, forms, procedures, files, equipment, and other such elements, and may be applied to materials, personnel, and equipment.

On-Line Processing: computer operations where data is fed into the machine and processed immediately; permits a response to be given to the operator without significant delay.

Order Subsystem: the group of library functions for ordering and receiving new library materials.

Organizational Areas: organizational areas are divisions of library activity that express commonality of purpose. For the example used in this draft, these divisions are administration, processing and services.

Organizational Units: are the units of library operations or activities that have been grouped in individual libraries for administrative control or convenience in costing.

Output: an output is the response to an input.

Overhead, External: the University's overhead rate, which includes expenditures in support of library operations which are not allocated to the libraries for their control.

Overhead, Internal: the cost of non-productive time reported by cost study participants. The costs of supporting tasks are allocated proportionately to the Order and Standard Loan internal overhead. Costs of non-production oriented activities are allocated proportionately to the overhead of these subsystems and to the activities excluded from the cost study which were designated "Non-Order or Standard Loan Tasks".

Parameters: definable characteristics of an item, device or system; a constant or variable in mathematics that remains constant during some calculation; may be assigned an arbitrary value.

RJE: Remote job entry.

Remote Batch Station: a terminal or other device at a distance from the computer that provides facilities for collection and inputing of large volumes of data via communication links to the computer for batch processing. Such a station may also provide for receiving volumes of processed data and for displaying or printing as well.

Replaceability: the degree to which a fraction of direct labor would be eliminated as a result of installing mechanized procedures. A 25% replaceable task is one where one quarter less labor would be required after the installation of mechanized procedures.

SAC: Subject Authority Control.

Software: the sets of instructions which are fed into a computer to tell it what to do.

Standard Loan Subsystem: the group of library functions for checking books out to patrons and getting them back into the library after use.

Subsystem: the major functional areas identified for the UC Library System. It included equipment, personnel, manual procedures, machine procedures, etc. A subsystem is a composition of interdependent modules which should be considered as a development unit. In some of the subsystems recommended for administrative functions, there is little or no interdependency. However in this area the module may be a more useful development unit.

System: a system is defined as a grouping of related modules that function together to achieve predetermined objectives. The basis of grouping may be functional and/or organizational relationships, or other local arrangements. Thus, a system is not necessarily congruent with the organizational structure of a particular campus library.

Tangible Benefits: benefits which can be measured in terms of real University budget dollars. They may represent reduced expenditures or future cost avoidance. For example, future absorption of a greater work load or the elimination of manual tasks in present operations represent measureable dollar savings.

Task: a task is the smallest unit of activity within a library module. It is normally a repetitive activity with a fairly precise definition of work output.

Transparent (to the User): a feature of automated systems meaning that the mechanisms and routines that implement a look-up, comparison, transaction, or display, obtain desired outputs without the user having to know or even be aware of the means of implementation.

UCUCS: University of California Union Catalog Supplement Project.

ULS: Union List of Serials.

UNCLSTAF: University of California Library Systems Task Force.

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What Is It?

The UC Library Systems Development Program (UCLSD) is a collaborative effort on the part of the libraries at all nine campuses of the University to apply computers in a coordinated and systematic way to library operations.

Who Favors It?

There appears to be virtual unanimity at responsible levels that the libraries should undertake a centrally coordinated, cooperative systems development program in preference to the continuation of nine locally funded, and sometimes very similar development efforts.

Why Do It?

There is general agreement on the soundness of steps being taken by the UC libraries. Those not directly involved in the library operations have suggested that a single University-wide systems development program might be a less costly way of providing new mechanized systems for some 70 libraries at the 9 campuses of the University. Those who manage library operations have been searching for the means to improve services with increasingly stringent budget constraints.

What Are The Costs?

The cost of developing new mechanized systems for ordering and circulating books alone will total $4,042,000 spread over the next six years.

How Will It Be Done?

The fundamental design concept includes local campus control over the use of the new mechanized systems with predominantly centralized implementation of the systems. Studies to date strongly suggest the desirability of a single large computer located centrally with small satellite computers at each of the campuses.

When Do We Start?

In a very real sense, the UCLSD Program is already under way and has been for five years. Based on the results of the Feasibility Phase, it has been recommended that the Requirements Phase for the Order Subsystem (and related parts of the Accounting Subsystem) be authorized to begin on 1 July, 1971.